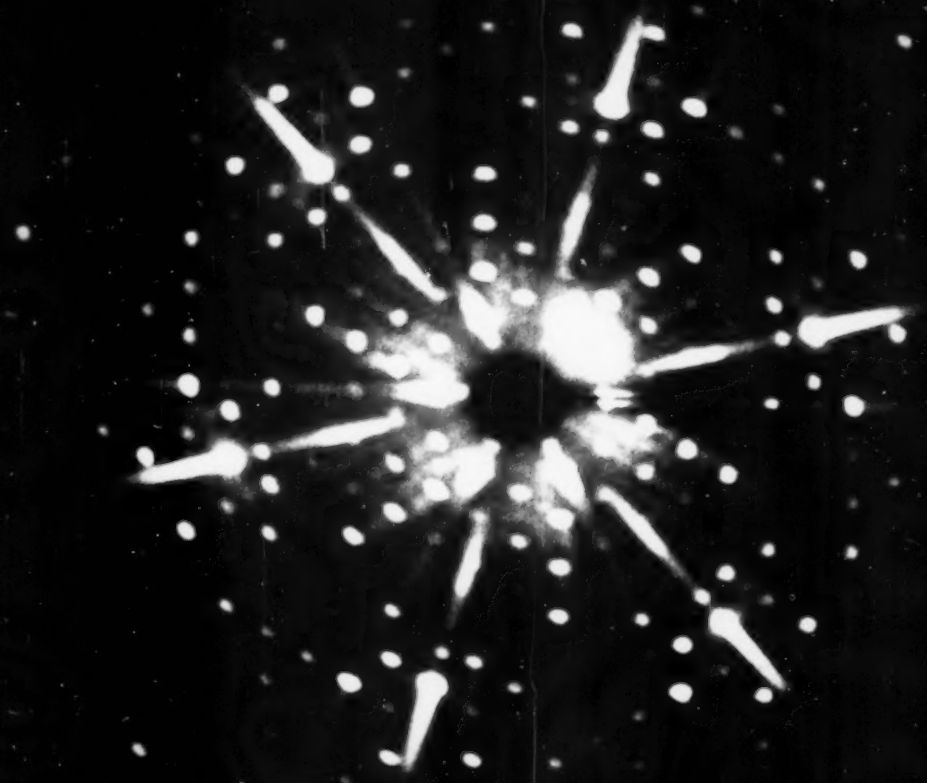
plating

JOURNAL OF THE AMERICAN ELECTROPLATERS' SOCIETY



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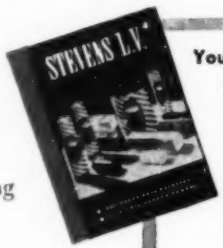

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Journal of the American Electroplaters' Society

December 1954 **Vol. 41, No. 12**

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Published by the American Electroplaters' Society, Incorporated. *Editorial, Advertising, Subscription,* **and** *Executive Offices:* **American Building, 445 Broad Street, Newark 2, N. J. Phone: HUmboldt 2-3400.** *Production Office:* **5800 N. Marvine Street, Philadelphia 41, Pa. Phone: LIvingston 8-7800. Subscriptions: Domestic and Canada, $4.00 for 1 year; $7.00 for 2 years; 50c a copy; Foreign, $8.00 a year; $1.00 a copy.**

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PLATING is abstracted regularly in Chemical Abstracts, Metals Review, Metallurgical Abstracts, Engineering Index, Technical Data Digest, and Bulletin Analytique.

Statements of fact and of opinion given in articles and papers in PLATING are those of the contributors. The American Electroplaters' Society assumes no responsibility for them.

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Published monthly at 5800 N. Marvine St., Philadelphia 41, Pa. Entered as second class matter July 1, 1946, at the Post Office at Philadelphia, Pa., under Act of August 24, 1916.

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THE COVER . . .

Two thousand years ago shepherds looked up and saw strange configurations of stars and lights in the sky. They looked beyond man's sight, beyond the scope of earth . . . and they knew that Christ was born in Bethlehem.

Today, we look into molecules and penetrate deeper into the microcosm. And here, on our cover is the result—a strange configuration of lights and pinpricks and we know . . .

The photograph is an X-ray diffraction pattern of nickel tetra-phosphorus trichloride taken with a Burger precision camera in the physics of solids section at Armour Research Foundation. It is through the courtesy of that Foundation that the pi ture is printed.

The photograph shows the 6-fold symmetry of the crystal whose space group is P3—one of the 230 geometrically possible space groupings. Such patterns are photographed in preliminary investigations of crystal structure determination.

So let us remember even as we rejoice in the new horizons that open to us that "plus ça change, plus c'est la même chose."

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Editorial

Christmas Thought

THE mind of man is a new geological phenomenon on our planet. Iron, as a pure metal, does not exist in nature yet millions of tons are produced annually. Aluminum, neoprene, uranium, et al fall in the same category; new species are created among flowers, plants and animals.

In the last fifty years there have been unprecedented developments in industry and in the application of science to industry. Our material world has, by this virtue, been changed; our thinking and our attitude towards our world have been modified by the new scientific knowledge.

The age of science and the age of the machine are the interdependent products of a common development. Back of the machine is the invention, back of the invention the idea, back of the idea the accumulated fund of scientific knowledge. The direct application of that knowledge made possible the immense accomplishment of modern industry. *The science of the centuries is at the tangent of the polishing wheel.*

Despite all this we are faced with a paradox: Thought is not a form of energy. How then has it changed the world, created new materials, made over the face of the earth? This is the great puzzle which gnaws at the philosophers of the modern day and tends to make philosophers of scientists and vice-versa.

One tentative beginning says that we have ended the "age of great experiments" and have embarked on the "era of great conclusions." We now have a tremendous store of facts which we can apply. The application brings with it still another dilemma for here we are with more facts, more lore, more knowledge than is humanly possible to digest within a reasonable time.

It is beyond the ken of human ability to encompass all the sciences. No man can be expected to study, to keep abreast, nor to have the time to investigate and to know all the technical complications, the abracadabra of mathematical tables, the innumerable applications and possible adaptations of these sciences. Modern knowledge has grown to span too great a field and has pushed the horizons of accomplishment much too far forward to expect that any one man can succeed alone.

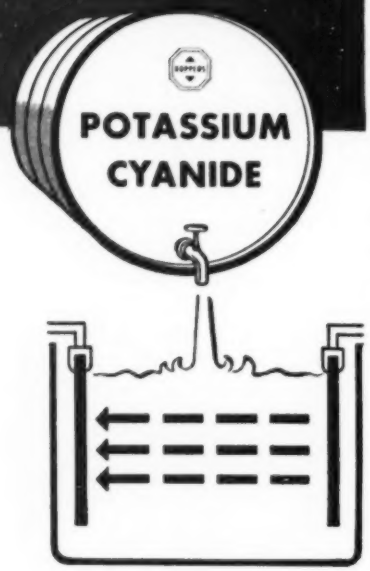
In this tremendous surge, electrochemistry has played its role and goes on playing it. Members of AES with their research, their interchange of knowledge and methods, their constant improvement of standards are incessantly adding to the refinement and applicability of their science. They are helping to mold the new "era of great conclusions."

In working together, AES members provide one answer to the frustrating paradox. As days merge into months and months into years we tend to lose sight of the immensity of the field in which we work and of the vast body of facts with which we grapple.

What better time to pause, then, than Christmastide to say to one another, "Carry forth the work we do for it is good. Take heart from yesterday's accomplishments and know that tomorrow will be even greater. Draw strength from the vistas that open to us—and let 'Merry Christmas' be the words that carry the full meaning of all our tomorrows."

THE EDITORS

How to save money by speeding-up your electroplating operation



If your normal plating operation includes the dangerous and troublesome step of dissolving cyanide granules for the plating bath, plus the time-consuming task of cleaning out so-called "empty" drums of poisonous cyanide powder dust, this proposition is directed to you.

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Potassium Cyanide is one of the many synthetic chemicals produced by Koppers. Others include Resorcinol, Styrene Monomer, Polystyrene, Phthalic Anhydride, Divinylbenzene, and Di-tert-butyl-para-cresol.

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Industry News

New Wyandotte Chemicals Los Nietos Plant Now in Production. Located 16 miles southeast of Los Angeles, at 8921 Dice Road, Los Nietos, Calif., this functional plant of Wyandotte Chemicals Corporation, Wyandotte, Mich., is one of the largest on the Pacific Coast

devoted to the production of specialized cleaning materials for business and industry. Carload and truckload production of both liquid and dry sanitary and maintenance cleaners, germicidal products as well as materials for metal cleaning, power laundering and commercial fruit peeling is already in operation. The new Wyandotte Chemicals California plant will also produce special products for the aircraft, railroad and petroleum industries.

Ford Ballantyne, Jr., vice-president and general manager of the J. B. Ford Division of Wyandotte Chemicals Corporation, announced in an informal dedication statement, "To keep pace with the very rapid growth of the southwestern part of the United States, it has been necessary for the J. B. Ford Division to move from our old facilities in Los Angeles where growth was restricted, to a new, modern plant in Los Nietos where we can continue to grow and keep abreast of sales demands. The new plant will also house modern and complete facilities for Wyandotte's West Coast Research and Technical Service Staffs. Our new plant will enable us to further improve our product quality and delivery time for our many customers in this area, as well as in Hawaii, Mexico and South America, and to the 170 jobbing firms and agents served by this Wyandotte Chemicals production facility."

Rumors of Copper Shortage Are False. Scare stories about the shortage of copper which have led some industrial users to search for substitutes are completely unfounded, one of the industry's leaders said recently. The metal is in ample supply, and copper production during the next year or two will be increasing by nearly one-fourth.

George W. Proffitt, Executive Secretary of the Copper and Brass Warehouse

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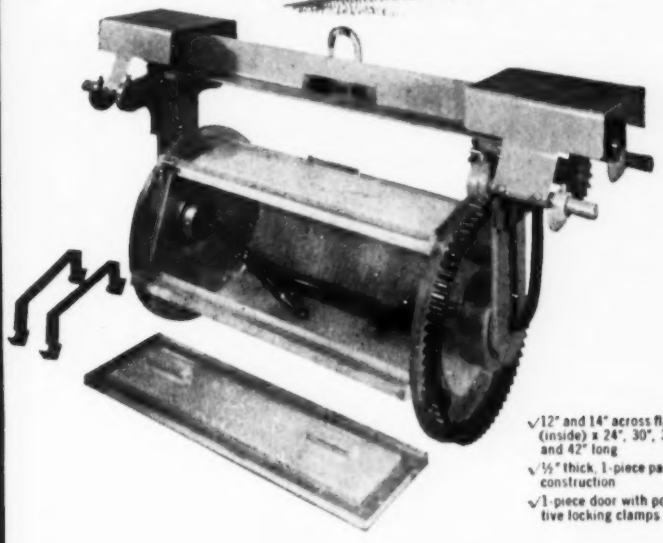
- Negative contact can be arranged to carry up to 800 amps.
- Loads up to 150 pounds



✓12" and 14" across flats (inside) x 24", 30", 36" and 42" long
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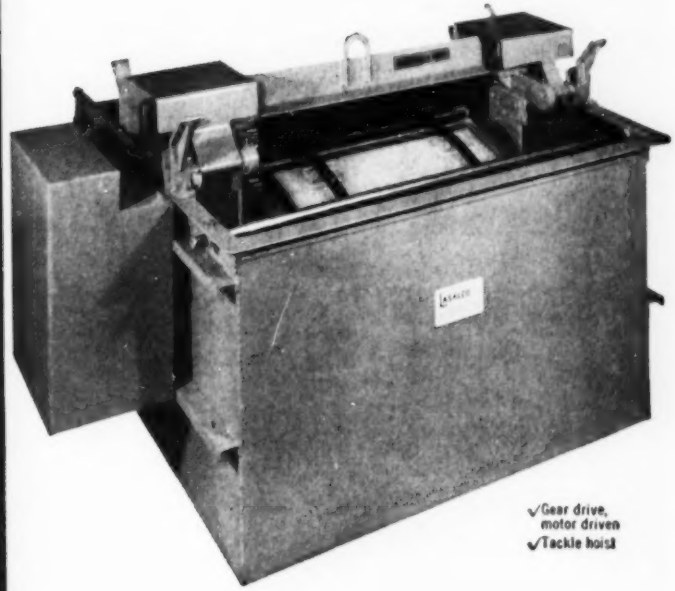

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Industry News

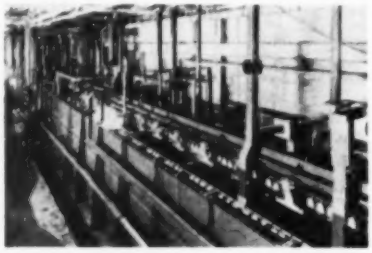
Association, told a meeting of construction industry officials, sponsored recently by the Chamber of Commerce of the United States, that during the last emergency, the propaganda regarding the shortage of copper was exaggerated.

"About every ten years somebody comes up with the prediction that the world copper reserves will be exhausted in 25 years," Proffitt said. "Before anybody has time to get excited about this pronouncement, the press carries news of the opening of vast new copper fields in Southern Rhodesia or somewhere and states the field covers thousands of square miles and the ore is the richest yet found. So . . . the oldest metal in use by man gets written off about every ten years only to come back in greater supply than ever before.

"During the most recent 'so-called' copper shortage many substitutes both metal and plastic came into use in many industries, including, of course, the construction industry."

Proffitt concluded his remarks by tracing some new uses of copper and brass in the construction industry, and pointed out that architects and construction people can depend upon copper and copper base alloys being on an immediate shipment basis.

Industrial Stamping and Manufacturing Goes Automatic. Industrial Stamping and Manufacturing Company, a division of Vinco Corporation, Detroit, recently "went automatic" with the installation of Udylite automatic plating equipment with all of the advantages of the latest developments in research and design, both mechanical and electrical.



This Udylite 24-station automatic return type plating machine replaces the former manual operations of copper, nickel, and chrome plating of automotive parts. The machine operates at a production speed of 50 racks per hour based on a 55 minute nickel plate and is equipped with 3000 ampere capacity carrier hooks. It has not only the standard Udylite variation of process timing but also is built so that a simple cam operation halves the time in nickel with the cleaning cycle remaining the same.

G. E. Announces Price Revision. A price revision including a 6 per cent average increase on its standard tools, standard blanks and special blanks, and a price decrease on large carbide pieces for die applications will become effective November 1, according to Carboloy Department of General Electric Company here.

Today's Manufacturer Can Make Good Use of the Atomic Era Right in His Own Plant. Gonzalo Segura, Jr., Chief Radiochemist of Foster D. Snell, Inc., told the Second Annual Conference of Industrial Inspection at Rutgers University that radio isotopes will help you tell whether your product's quality is up to snuff as it rolls off the production line.

Segura, in his talk, "Practical Applications of Radioisotopes to Quality Control Problems," told how radioactive strontium-90 is being used in thickness gages to measure continuously the thickness of such materials as paper and plastic sheets or ribbons as they are being produced. Variations in thickness are electronically relayed back to the production line so that uniform thickness is maintained.

For industrial radiography the radioisotope cobalt-60 is just as effective, less expensive, lighter, and more portable as compared to X-rays. The level of liquids and foams in tanks may now be determined by using radioactive floats.

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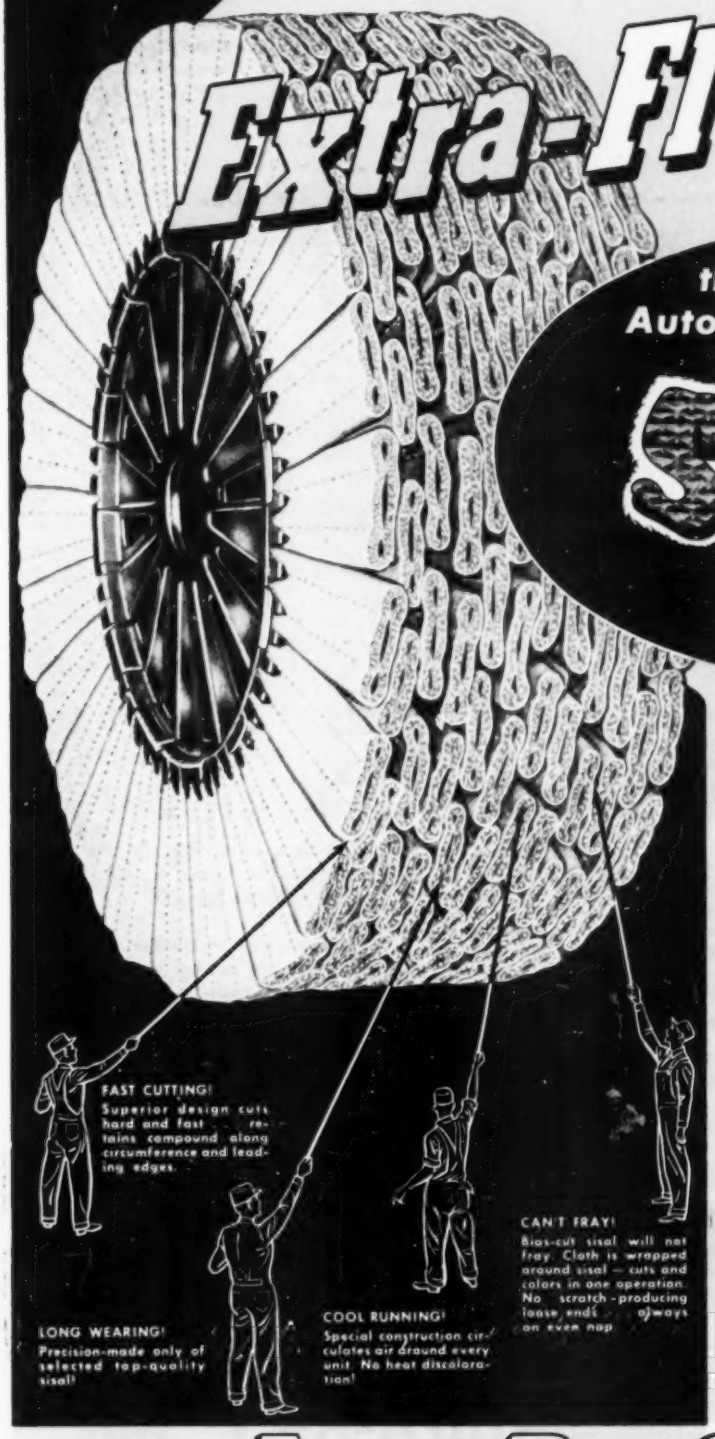
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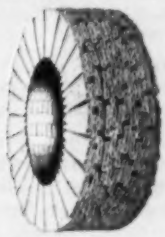

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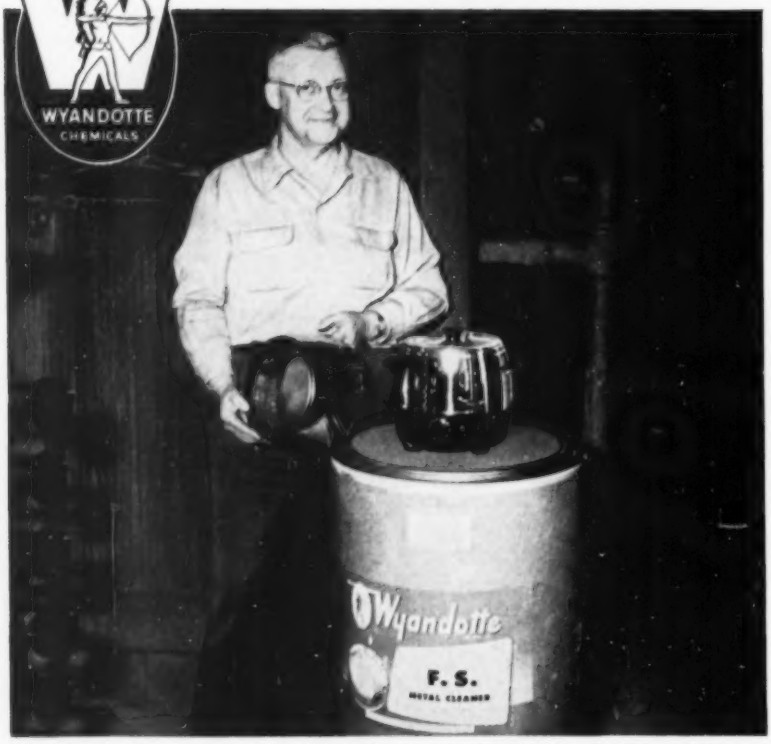

Supt. Hice Ramsey shows the quality plating he gets after cleaning with Wyandotte F. S.

Dominion Electric reduces plating rejects with Wyandotte B. N. and F. S.* cleaners!

"Exhaustive tests with Wyandotte metal cleaner compounds in our automatic plating operations have proved most gratifying. We are particularly pleased with the consistently good results from Wyandotte electrocleaners, B.N. and F.S.," reports Hice Ramsey, Superintendent, Plating and Polishing Dept., Dominion Electric Corporation, well-known appliance manufacturer, Mansfield, Ohio.

"We are experiencing *fewer rejected parts* and our over-all *economy* is meeting the demands of our engineering department."

B.N.—a versatile direct- or reverse-current electrocleaner — for excellent preparation of ferrous and non-ferrous metals, including buffed nickel, for plating.

F.S. — a heavy-duty, reverse-current electrocleaner for ferrous metals . . . removes lubricating oils, compounds and "smut." F.S. has long solution life, high conductivity; it's tops for economy and efficiency.

Other Wyandotte products used by Dominion Electric are: W.L.G.*, a "soak" cleaner for ferrous metals, and Wyandotte ZORBALL, the all-purpose floor absorbent that won't cake, mud or dust.

If you have a metal cleaning or plating problem, give your Wyandotte representative or jobber a call. He'll help you produce better plated products at lower costs. *Wyandotte Chemicals Corp., Wyandotte, Mich. Also Los Angeles 12, California.*

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Industry News

Other uses cited were the determination of leaks in buried pipes, tracing liquid flow, and the elimination of static charges. Safety devices worn by workers in the form of rings having a radioactive source will stop a hazardous operation when the worker approaches too close.

Segura said that present research on the cold sterilization of foods and pharmaceuticals using radioactivity indicates that they soon will be displacing and supplementing the present sterilization technics.

Baldwin-Gregory Company to Counsel on Hot Dip Galvanizing Problems. Announcement is made of the formation of the Baldwin-Gregory Company, located at 121 Kemp Avenue, Fair Haven, N. J., as consultants on hot dip galvanizing problems.

The company will specialize in the surveying of existing plants or departments and recommending of improvements. It will layout, plan, and supervise the installation of new plants or the rearrangement of present ones, including assistance in securing equipment, designing special equipment, and training operating personnel.

The new company will bring to bear over 25 years of experience in the practice and theory of hot dip galvanizing in its top executives, Allen T. Baldwin and William P. Gregory. Baldwin is manager of Flux sales with Hanson-Van Winkle-Munning Company, at Matawan, N. J., and Gregory is vice-president of New Jersey Galvanizing and Tinning Works, Inc., at Newark, N. J. Both men will retain these positions in addition to functioning as executives at the Baldwin-Gregory Company.

Comprehensive Market Analysis. A comprehensive market analysis of sales of manual material handling equipment among 14 principal industry groups, is detailed in a report just published by the Caster & Floor Truck Manufacturers Association, Chicago.

This analysis is one of the most extensive ever developed. One section gives both dollar and percentage figures for specific industries according to seven classifications of manual equipment: two-wheel trucks, four-wheel trucks, trailers, skids, casters, wheels, and repair parts.

Industry groups covered include food, textile, lumber and wood, paper and printing, chemical, oil and coal, stone, clay and glass, prime metal, fabricated metal, miscellaneous manufacturing and ordnance, transportation, warehousing, utilities, retail and wholesale.

The purpose of the market analysis is to provide a complete story of the most productive area for sales of manual handling equipment. Because such a study

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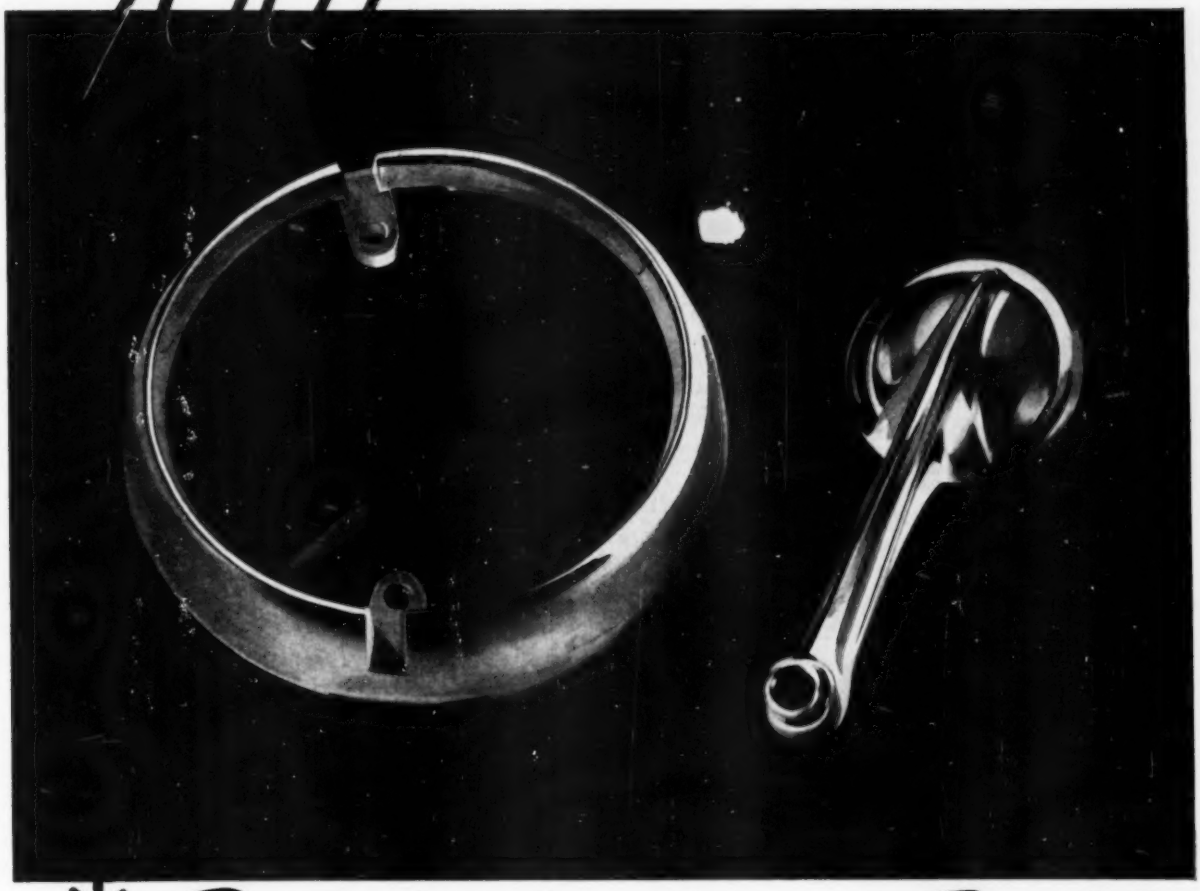


* Satisfied with your Finish?

* **looking for the best finish possible within the range of competitive production costs?**

Investigate our Lea-Ronal Bright Copper Process with Lea Copper-Glo.

You can secure the same following advantages as the numerous present users of the Lea-Ronal Bright Copper Process:

- **it produces a brilliant, soft ductile deposit, ideal for subsequent bright nickel or chrome plating.**
- **it reduces nickel requirements because nickel is not needed to build brightness.**
- **high speed plating.**
- **the brighteners are completely stable—even when idle for prolonged periods.**
- **carbonates tolerated to saturation without any harmful effect on plating range.**
- **can operate with mechanical or air agitation.**

There are other advantages but these six—all outstanding—will give you an idea as to what you can expect if you convert your tanks—still or barrel—to the Lea-Ronal Process using Lea Copper-Glo. Ask for a laboratory test sample. Better yet, order sufficient quantity to make a good trial production run in your plant. **Write or phone The Lea Mfg. Co., 16 Cherry Avenue, Waterbury 20, Conn., through whom the Lea-Ronal Bright Copper Process and Lea Copper-Glo are exclusively marketed.**

If you have a technical problem on copper plating on which our engineering staff could be of help, tell us about that, too.

Lea-Ronal, Inc.

Sales and Manufacturing Plant:
237 East Aurora Street, Waterbury 20, Conn.
Main Office and Laboratory:
42-48 27th Street, Long Island City 1, N. Y.

would cost a single company many thousands of dollars to prepare, the Association has made this information available to nonmembers.

This analysis, prepared on a confidential basis, may be obtained by industry in general at $100.00 a copy.

Set 37 Sessions for Plant Maintenance Conference. Thirty-seven sessions have been arranged for the three-day Plant Maintenance & Engineering Conference at the International Amphitheatre, Chicago, January 24-26, it was announced by Clapp & Poliak, Inc., founders and producers of the meeting. L. C. Morrow, consulting editor, "Factory Management & Maintenance," will act as general chairman.

The conference, largest industrial meeting of its kind, is held concurrently with the four-day Plant Maintenance & Engineering Show. About 20,000 production and maintenance executives and engineers are expected to attend the show to inspect the equipment of more than 350 manufacturers.

Separate round-table sessions will be set up for each of five industries. These include the chemical industry, food, paper, steel and textiles. One sectional conference will be devoted to the process industries.

Advance registration cards for both the show and conference may be obtained from Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y.

Robertshaw Research Center to Develop Control Devices for Home Appliances and Industry. A $1,000,000 research center that will develop new control devices for home appliances and industry has been formally opened at Irwin, Pa., by Robertshaw-Fulton Controls Company, leading manufacturer of thermostatic and pressure controls.

The new research and development installation forms a major link in the company's current national expansion program, which in addition includes a $2,500,000 plant under construction at Long Beach, Calif.; a $2,000,000 plant under construction at Milford, Conn.; a new plant at Toronto, Ontario; and a $500,000 special military research laboratory at Anaheim, Calif.

The Robertshaw Research Center, whose staff will include engineers, physicists, chemists, technicians, and draftsmen, will serve as research and development headquarters for the company's seven manufacturing divisions. Other major research facilities are maintained at Los Angeles and Anaheim, Calif.

W. H. Brandt To Head New Products Engineering For Westinghouse. A. C. Monteith, vice-president in charge of engineering for Westinghouse Electric Corporation, has announced the formation of a new products engineering department to be headed by Dr. W. H. Brandt.

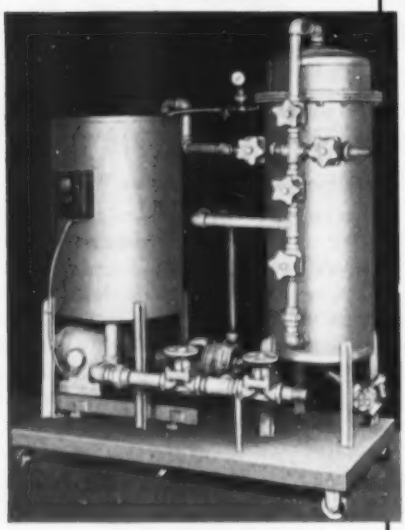
Work of the new department will be closely coordinated with that of the Westinghouse research laboratories and the materials engineering department.

French Group Pays General American Transportation Corp. Half Million for Process Rights. William J. Stebler, President of General American Transportation Corporation (Chicago), announced that General American has signed a contract, with a half-million dollar rights payment, with the Société Europenne de Revetement Chimique (S.A.) licensing that company exclusively to use and to sublicense General American's Kanigen plating process in several countries and territories abroad. The Société, a new company to be known as SEUREC, is composed of ten well established French industrial firms.

Stebler stated that SEUREC's initial fee of $500,000.00 covers rights to the process, and continuing royalties will be paid, based upon pounds of nickel deposited by SEUREC and its sublicensees, during the next 20 years. One-half of any

FILTER OUT SOLUTION WASTE AND REDUCE REJECTS

WITH WAGNER BROTHERS FILTERS



YOU CAN STOP SOLUTION WASTE AND MINIMIZE REJECTS CAUSED BY IMPROPERLY FILTERED SOLUTIONS.

HOW? You can be sure of your solutions (and plating quality) when solutions are filtered through a Wagner Brothers Filter. It removes all suspended impurities and sludge down to 1/10 micron — and, because of a higher effective flow rate than any other equipment of comparable size, it filters faster at lower cost.

WHY? Wagner Brothers Filters are superior to ordinary filters because of better design and construction. Permanent membranes, caked with a few cents worth of filter-aid (diatomic particles), furnish the filtering medium. The membranes are there to stay. You have no problems of replacing bags, sheets or pads—there are none. Imagine what you can save on maintenance.

Cleaning is simply a matter of turning a few valves, allowing the air bump backwash to do all the work of flushing waste residue. There is no manual cleaning labor or disassembly required—and, the whole cleaning process takes only 20-minutes.

This highly efficient filter is available in 8 standard models, with iron, stainless steel or Velon lined tanks. Membranes furnished are either stainless steel, porous stone or porous carbon, depending upon application. All models are platform mounted on casters for ease of movement. Capacities of standard models range from 560 to 15,000 GHP. Of course, Wagner Brothers will also design and build specials to suit your needs.

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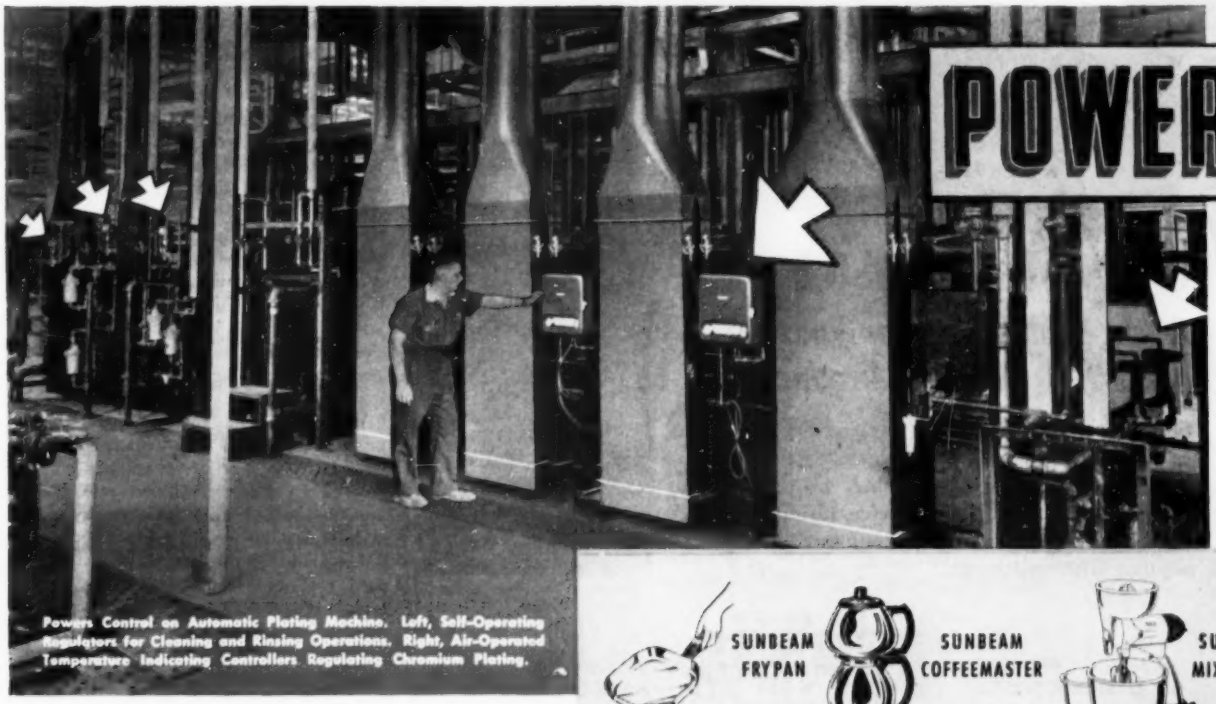


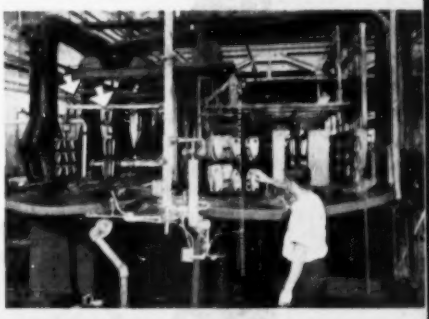
Powers Control on Automatic Plating Machine. Left, Self-Operating Regulators for Cleaning and Rinsing Operations. Right, Air-Operated Temperature Indicating Controllers Regulating Chromium Plating.

Sunbeam CORPORATION ASSURES HIGH-QUALITY VOLUME PRODUCTION FINISHING WITH POWERS TEMPERATURE CONTROLS

Metal finishing operations at *Sunbeam Corp.* are critical. A world-known reputation for quality appliances makes rigid final inspection essential. Yet, high-volume production must be maintained on modern automatic metal finishing equipment.

As an essential aid to high-quality, high-volume metal finishing operations, *Sunbeam Corp.*, uses Powers Temperature Control Equipment extensively throughout their Chicago and Canadian plants.

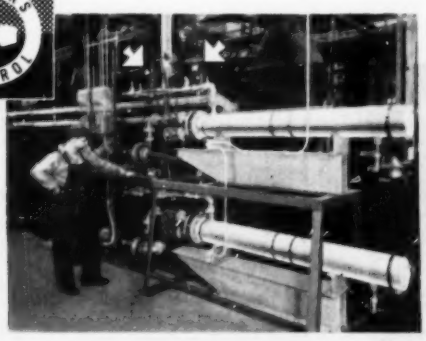
Powers Temperature Controls can help you, too . . . whether your plant be large or small. They'll help you turn out a better product, while saving you money. Contact the Powers office nearest you, or write us direct.

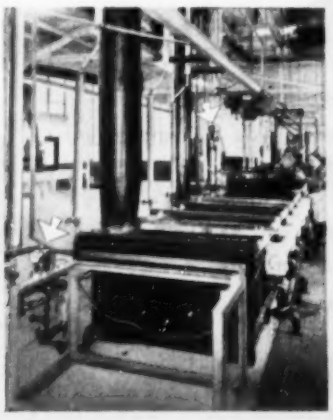


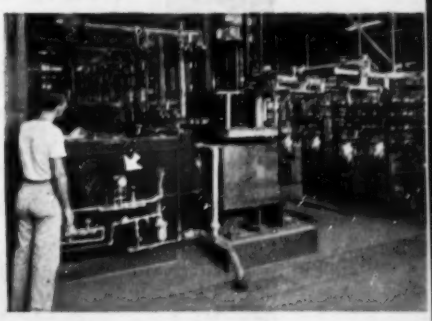
Above: Controls on Copper Plating Machine.

Right: Self-Operating Controls on Barrel Type Plating Machine.

Below: Controls on Heat Exchangers.







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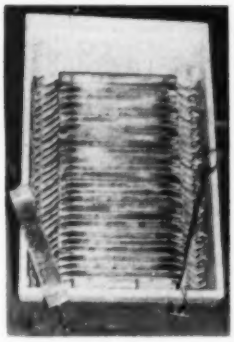

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More Mutual Chromic Acid is used than any other brand because the metal finishing industry has found Mutual's record to be outstanding on all three counts.

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Industry News

sublicensing fees received by SEUREC will also be paid to General American. The license and sublicenses include the right to use the registered trade name "Kanigen," which identifies the practice of chemical nickel plating by General American and its licensees.

Kanigen was introduced by General American two years ago as an entirely new type of nickel plating and is now being used extensively in industry. Its distinguishing features lie in the fact that it is purely a chemical process, it requires no electricity, and pieces of many shapes, sizes and many basis materials can be plated with virtually zero porosity. A minimum thickness of plate is required even on extremely complicated shapes, and thickness can be meticulously controlled. The process was originally developed by General American to make possible the nickel plating of the interiors of tank cars to prevent contamination of fluids carried in the cars. It is now being used primarily for the plating of very large objects, of small or complicated products that cannot be economically or satisfactorily plated in the traditional way, and where virtually zero porosity is required with a minimum of plating.

Highways Are Being Welded Together. In a statement made at the official opening of the company's new welding plant, R. C. Freeman, general manager of General Electric's welding department, pointed out that "steel reinforcements for highways are being welded to provide more durable thoroughfares for the country's heavy traffic load. This method is gradually replacing the old-fashioned, time-consuming manual joining process," he said.

Freeman cited several other new techniques of electric arc welding used in joining aluminum for aircraft, new wonder metals for nuclear reactors, and fabricating of modern metal homes.

Sustaining Memberships

Four more organizations have joined the AES Research Sustaining Membership program. The new members are:

Preston Products Co., 1700 Alpine Ave., N. W., Grand Rapids 4, Mich.

Kelite Products, Inc., 3401 W. Touhy Ave., Chicago Ill. Attn: Mr. S. B. Pieters, Mgr.

P. B. Gast Co., 1515 Madison, S. E., Grand Rapids, Mich.

R. Lavin and Sons, Inc., 3426 South Kedzie Ave., Chicago 23, Ill.

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From Our House to Your House this year of our Tenth Anniversary!

With many pleasant memories of our past ten years' associations, we look forward to the future with the promise that ROHCO® Research will continue to contribute to plating advancement.

We wish you a Very Merry Christmas and a Happy New Year!

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you can get this brilliant finish directly on zinc die castings!

No electroplating—no mechanical finishing!

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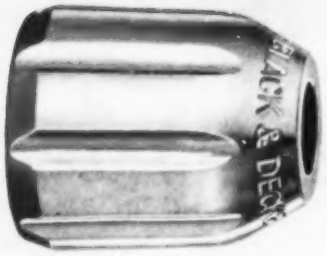

TREATED WITH NEW IRIDITE

NEW

IRIDITE® (Cast-Zinc-Brite)

Brightens zinc die castings by chemical polishing, protects against corrosion

NOW, FOR THE FIRST TIME you can get a brilliant, decorative finish directly on zinc die-cast parts . . . without mechanical finishing, without electroplating! The luster is provided by the *chemical polishing* action of new Iridite (Cast-Zinc-Brite) solution. Even surface blemishes, such as cold shuts, are brightened by this new process. No electrolysis. No special equipment. No specially trained personnel. Just a simple chemical dip for a few seconds and the job is done. And, this new Iridite has been *tested and proved* in production.

CORROSION RESISTANCE, TOO! New Iridite (Cast-Zinc-Brite) provides exceptional corrosion resistance for bright-type chromate finishes . . . also guards against blueing or darkening by eliminating zinc plate formerly required in bright chromate finishing of zinc die castings.

AS A BASE FOR ELECTROPLATING—Lower mechanical finishing costs are possible where plated finishes are *required* since the brightness provided by this new Iridite may be sufficient.

LET US SHOW YOU what Iridite (Cast-Zinc-Brite) can do for you. Send us at least a half-dozen typical zinc die-cast parts for FREE PROCESSING for your own tests and evaluation. Or, for immediate information, call in your Iridite Field Engineer. He's listed under "Plating Supplies" in your classified 'phone book. *IMPORTANT: when you give us samples for test processing, please be sure to identify the alloy used.*

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WANTED—Hard Chrome Plater, must be thoroughly familiar with all phases of hard chrome plating on job work. All inquiries will be handled confidentially. Salary arranged. Boston area. Reply to: P-1254-A, PLATING, 445 Broad St., Newark 2, N. J.

WANTED—Salesman to represent a Large Plating Chemical Supply Company. Selling to Platers and Manufacturers. Other lines may be carried. Reply to: P-1254-B, PLATING, 445 Broad St., Newark 2, N. J.

SITUATION WANTED—Chemist, 36, seeks South Jersey position or nearby area; exp. batteries, glues, gelatines, nylon throwing, gen. physical and chemical comm. testing, and plating (copper, tin, nickel, cadmium, chromium). Reply to: P-1254-C, PLATING, 445 Broad St., Newark 2, N. J.

SITUATION WANTED—Graduate chemical engineer with fifteen years plating experience desires administrative position that will fully utilize training and experience. Good record in cost reduction, quality improvement, and technical, mechanical, productive and administrative aspects of plating. Family man. Will relocate. Reply to: P-1254-D, PLATING, 445 Broad St., Newark 2, N. J.

SITUATION WANTED—Chemist, metal cleaning, experienced in the formulations of alkali cleaners (soak and electro for all metals), solvent emulsion cleaners, burnishing compounds, acid cleaners and paint strippers. Reply to: P-1254-E, PLATING, 445 Broad St., Newark 2, N. J.

SITUATION WANTED—Chemist, 5½ years experience, including chemical testing to Government specifications (copper, nickel, chromium, cadmium, zinc, silver, gold, plating on aluminum, anodizing, various metal treatments), personnel relations, interested in research or control in New York or New Jersey area. Reply to: P-1254-F, PLATING, 445 Broad St., Newark 2, N. J.

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L—200. Surface Preparation—An illustrated, two-color bulletin on surface preparation has recently been made available by the Protective Coatings Division of Metalweld, Inc. This bulletin points out the importance of proper surface preparation in all coating or painting applications and discusses the possibility of coating failures due to adhesion loss, osmotic blistering and under-film corrosion when the preliminary cleaning operation is poorly executed. Bulletin shows photographs of actual sandblast jobs and describes briefly the various methods used by the MW Protective Coatings Division to produce clean, roughened, keyed surfaces that insure a good bond and a lasting finish.

L—201. Insulated Plating Rack Sections—A new 12-page illustrated catalog, issued by Belke Mfg. Co., shows how many different rack styles can be assembled from a small assortment of insulated rack sections; how removable contact tips are joined to rack frame with leak-proof seal; how insulated contact tips can be adjusted or reformed to rack all kinds of articles.

L—202. Electroplated Palladium, Platinum—Recognizing the industrial need for a valid analysis of the properties of electroplated precious metals now coming into prominence as "industrial metals," Technic Inc., has issued an authoritative data sheet on electroplated palladium and electroplated platinum.

For each metal, the Technic compilation describes physical properties, from atomic weight to reflectivity, and electrical properties, from resistivity to specific magnetic susceptibility. Corrosion resistance is also detailed, along with hardness electroplated, electroplating specifications, and thickness requirements. Cost of electroplating per square foot is estimated. The sheet is organized in convenient form to make all details available at a glance.

Copies of the new Electroplated Palladium and Electroplated Platinum Data Sheet, as well as the same company's Electroplated Gold and Electroplated Rhodium Data Sheets, are available.

L—203. Die Casting—A new 28-page, two color, profusely illustrated booklet describing the die casting process and its application is now available from the American Zinc Institute, Inc.

The booklet, entitled "Die Casting—Molten Metal to Finished Part—Direct," discusses this important production method as it affects product design, machining requirements and surface finish. The basic steps of the die casting process itself are shown pictorially. Also included are concise descriptions of the dies and machines used to produce uniform parts of complex shape within close dimensional limits.

L—204. Double-Duty Hardness Tester Bulletin—A four-page bulletin, describing the characteristics and use of the new Kentrall Hardness Tester, has been published by the Torsion Balance Company. The bulletin describes the manner in which the instrument performs tests in both the superficial and regular ranges of Rockwell hardness testing.

L—205. Hevimet—A new technical data sheet covering the latest information on machinability and other physical properties of Hevimet, a high tungsten alloy—twice as heavy as lead—produced by powder metallurgy, is announced by Carboloy Department of General Electric Company.

The data sheet, HV-4, also includes a graph comparing the absorption rate of Hevimet and lead under a narrow beam of Cobalt 60, in addition to detailed mechanical, thermal, electrical and other property evaluations.

L—206. Burners—Bulletin No. 107 on the Thermal Corporation's high velocity oil burners is now ready for general distribution. It contains complete information including operating principles, applications, dimensions and output data. These burners are particularly well suited for use in furnaces, ovens and dryers, kilns and in numerous specialized applications such as ladle heating, skelp furnaces, pressurized air heaters, bell kilns and submerged combustion equipment.

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$ .75 to AES members
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The first, $5.95 to members
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The second, $7.22 to members
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Racks for any job when you need them.
No delay—no waiting.

Quick and easy conversion.
Racks easily changed to fit different jobs—you can have top efficiency on every job.

Replaceable Tips for easy tip upkeep.
Enable you to keep every rack at full capacity.

Tremendous saving in plating rack costs.
You can make new racks designed for the job from members of discarded Thinker Boy Racks at the mere cost of assembly.

No added investment necessary. *Here's how you can cash in on the tremendous time and money saving economy of Thinker Boy Racks without investing an extra dime.*

1. When you need racks get *Thinker Boys.* Vac-Seal replaceable tips enable you to keep every Thinker Boy Rack at full capacity.
2. When Thinker Boy Racks of one design are no longer needed, convert them to a design you need or disassemble and store the parts.
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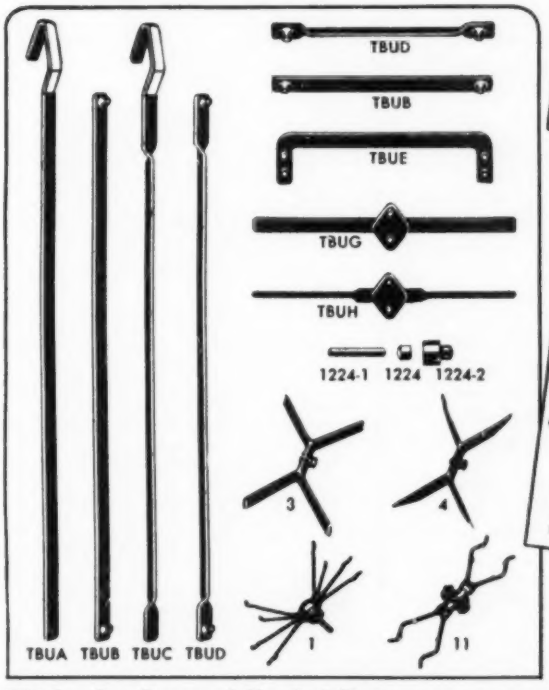
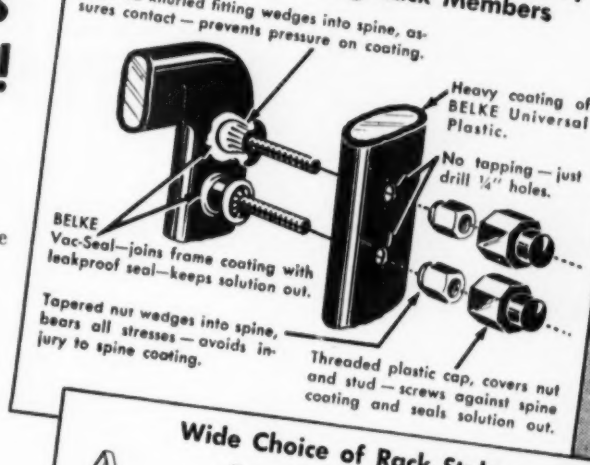
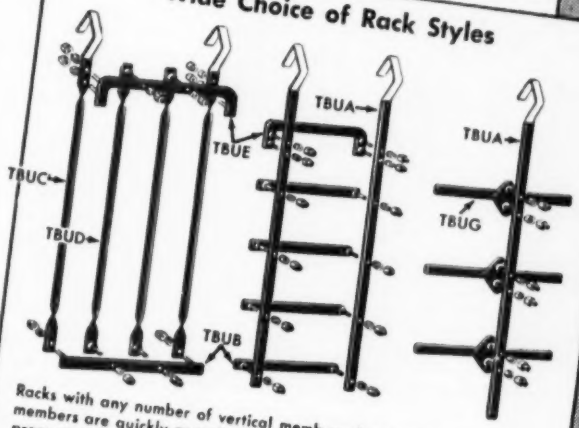


Thinker Boy Precoated Vac-Seal Parts are mass produced for low cost and carried in stock for prompt shipment. Furnished in any assortment or assembled to your specification. Ask your BELKE Service Engineer or write for descriptive bulletin and parts list.

LEAKPROOF ASSEMBLY of Thinker Boy Precoated Plating Rack Members

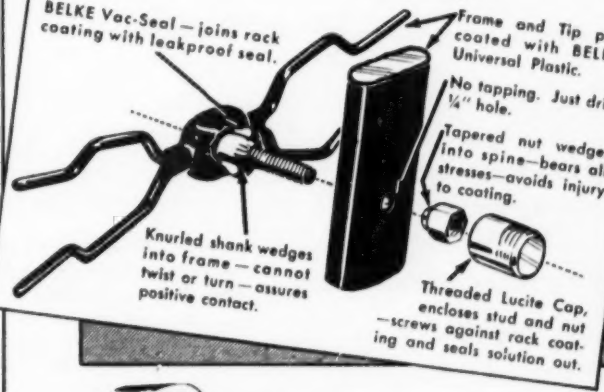

Tapered knurled fitting wedges into spine, assures contact — prevents pressure on coating.
Heavy coating of BELKE Universal Plastic.
No tapping — just drill ¼" holes.
BELKE Vac-Seal—joins frame coating with leakproof seal—keeps solution out.
Tapered nut wedges into spine, bears all stresses — avoids injury to spine coating.
Threaded plastic cap, covers nut and stud — screws against spine coating and seals solution out.

Wide Choice of Rack Styles



Racks with any number of vertical members, horizontal members or T members are quickly assembled from a small selection of Thinker Boy precoated Vac-Seal Parts—¼" drill and pliers are only tools needed.

LEAKPROOF MOUNTING of Vac-Seal Precoated Tips


BELKE Vac-Seal — joins rack coating with leakproof seal.
Frame and Tip precoated with BELKE Universal Plastic.
No tapping. Just drill ¼" hole.
Tapered nut wedges into spine—bears all stresses—avoids injury to coating.
Knurled shank wedges into frame — cannot twist or turn — assures positive contact.
Threaded Lucite Cap, encloses stud and nut —screws against rack coating and seals solution out.

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Personals

Dr. R. L. Womer has been appointed as Speer vice-president, according to an announcement made by Speer Carbon Co., St. Marys, Pa. He will be in charge of research and development.

Womer

Dr. Womer formerly was assistant for Divisional Research, Olin Mathieson Chemical Corporation.

Dr. R. C. Gibson, formerly technical director, has been appointed to assistant vice-president, **E. W. Richards** technical director, **R. I. Peterson** service manager, and **C. F. Rasmussen** assistant service manager, according to an announcement by **Robert W. Englehart,** president, at the annual sales-service meeting of the Parker Rust Proof Company, held in September at the home office in Detroit.

The sales-service meeting, an annual affair, brings in all Parker sales and service representatives from this country and Canada for intensive training in new products, new developments and new techniques.

George W. Benbury has been promoted to the position of assistant general purchasing agent of the Pennsylvania Salt Manufacturing Company, **Fred G. Prince,** general purchasing agent, announced.

In his new capacity, Benbury will direct the activities of the construction equipment and containers sections of the central purchasing office in Philadelphia, while **Allen E. Miller,** in a similar assignment, will continue in charge of the supplies, raw materials, and fuels section.

M. A. Burello, formerly with the market research and sales promotion department of E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del., has joined the product planning group of Carboloy Department of General Electric Company. He will specialize in market development of vacuum-melted products ranging from high-temperature jet engine alloys to specialty ferrous and nonferrous metals.

Burello, who participated in end-product research on titanium at Du Pont, and on ferro-alloys prior to that

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1—7500/3750 AMPERE, 9/18 VOLT, **HANSON-VAN WINKLE-MUNNING,** Synchronous.
1—5000/2500 AMPERE, 9/18 VOLT, **COLUMBIA.**
1—5000/2500 AMPERE, 8/16 VOLT, **CHANDEYSSON,** 25° C., Exciter-in-head.
1—5000/2500 AMPERE, 6/12 VOLT, **CHANDEYSSON,** 25° C., Synchronous, Exciter-in-head.
1—4000/2000 AMPERE, 6/12 VOLT, **CHANDEYSSON,** 25° C., Exciter-in-head.
1—3000/1500 AMPERE, 6/12 VOLT, **COLUMBIA,** Synchronous.
1—2500/1250 AMPERE, 9/18 VOLT, **ELECTRIC PRODUCTS,** Synchronous, Exciter-in-head.
1—2000/1000 AMPERE, 8/16 VOLT, **ELECTRIC PRODUCTS.**
1—1500/750 AMPERE, 6/12 VOLT, **HANSON-VAN WINKLE-MUNNING,** Synchronous, Exciter-in-head.
1—1500/750 AMPERE, 12/24 VOLT, **CHANDEYSSON,** Synchronous, Exciter-in-head.
1—1000/500 AMPERE, 6/12 VOLT, **ELECTRIC PRODUCTS.**

ANODIZERS

1—4000 AMPERE, 40 VOLT, **CHANDEYSSON,** Exciter-in-head.
1—1500 AMPERE, 40 VOLT, **HANSON-VAN WINKLE-MUNNING,** Exciter-in-Head.
1—1000 AMPERE, 40 VOLT, **CHANDEYSSON,** 25° C.
1—1000 AMPERE, 30 VOLT, **IDEAL,** Exciter-in-head.
1—750 AMPERE, 60 VOLT, **HANSON-VAN WINKLE-MUNNING,** Synchronous, Exciter-in-head.
1—500 AMPERE, 25 VOLT, **CHANDEYSSON,** Synchronous, Exciter-in-head.
1—400 AMPERE, 40 VOLT, **M. G. C.,** Exciter-in-head.

RECTIFIERS

1—2000/1000 AMPERE, 6/12 VOLT, **G. E.,** COPPER OXIDE, with Manual Control.
1—2000/1000 AMPERES 6/12 volt G. E., brand new selenium stacks, with "On-load" Automatic Voltage Regulator.
1—**GREEN SELECTOPLATER,** 1800 AMPERE, 12 VOLT, 220/3/60.
2—**UDYLITE-MALLORY,** 1500/750 AMPERE, 6/12 VOLT, Control.

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1—**RANSOHOFF** SPIRAL HOT AIR DRYER.
1—**CROWN** 2-COMPT. HORIZONTAL DE-BURRING MACHINE, each compt. 20" x 36", Unlined but can be lined.
1—**CROWN** 1-COMPT. HORIZONTAL DE-BURRING MACHINE, 60" x 36", Unlined but can be lined.
2—**CROWN** CENTRIFUGAL DRYERS, Size No. 1 and Size No. 2, Steam Heat.
1—Production Pipe Polishing Machine, Model 101, Motorized.
1—**RONCI** No. R-200 Enameler
1—**ACME** L-4 SEMI-AUTOMATIC BUFFING MACHINE.
3—**U. S. E. L.** TOOL, Mod. 110, TWIN 15HP POLISHING LATHES.

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It all adds up!

+ Long-time service —
"Custom-Built" Selenium stacks are hand-assembled from matched, pre-tested selenium plates. Have no 'weak spots' where failures can start. All components are protected against heat and corrosion, and have practically unlimited life.

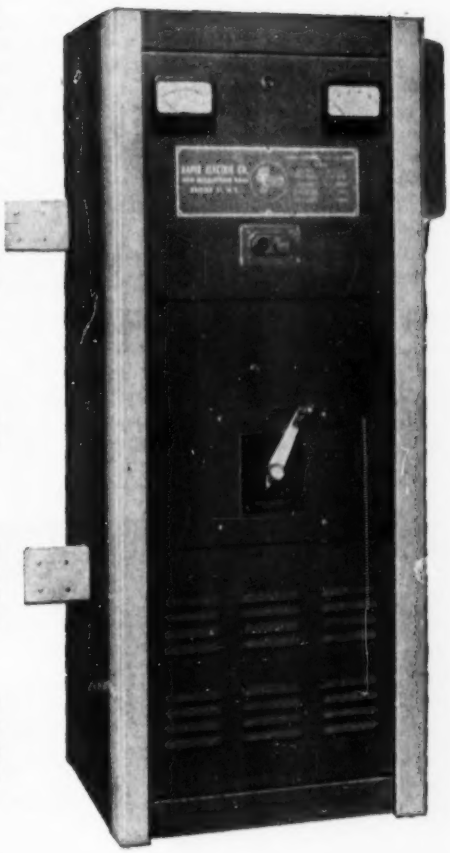
+ High efficiency —
"Custom-Built" stacks and the heavy-duty transformer combine to deliver DC power at high efficiency, eliminate unnecessarily prolonged runs, save on power bills.

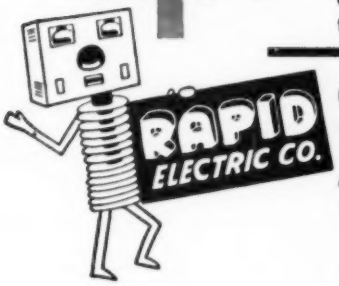
+ No loss of efficiency due to overheating —
Effective updraft-type cooling system permits full-load operation even at room temperatures up to 110°F.

+ No lost time due to burnouts —
Oversize copper bus throughout to handle normal overloads. Built-in "three-way" automatic protection guards against dangerous overloads.

+ No supervision needed —
Connect to AC line and DC bus, set the convenient, one-knob output control, then touch the button on the electromagnetic starter — that's all there is to operating it.

+ No maintenance needed —
Only moving parts are in heavy-duty totally enclosed fan motor.





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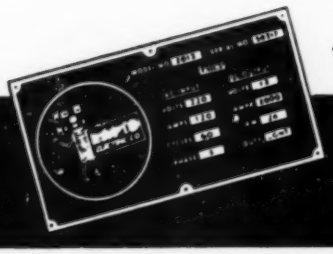
Your Best Source of DC Power

Rapid Electric Selenium Rectifiers are available in bench models and in floor models ranging in size up to 250 KW — DC output capacity, with four types of controls: (1) as a basic model (for fixed voltages), (2) with half-controls (for the upper half of the range only), (3) with full controls (for the entire range) and (4) with remote full controls.

Catalog K is available, giving full details.

THE NAMEPLATE THAT MEANS *"More Power to You!"*



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Personals

when associated with Vanadium Corp. of America in Pittsburgh, Pa., holds a B.S. degree in metallurgical engineering from Queens University, Kingston, Ont.

Victor C. McBride has been named as sales representative of the J. J. Siefen Company.

He will work out of the home office at 5657 Lauderdale and cover northwestern Ohio and southeastern Michigan, as well as Detroit.

Herbert A. Skelton, professional engineer, has been appointed vice-president and general manager of Scancraft Plating, Ltd., metal finishing engineers.

Skelton is a graduate of the University at Toronto, 1940, and is a past president of the American Electroplaters' Society, Toronto branch.

Prior to joining the firm, Skelton was for many years chief metallurgist and chemist of the John Inglis Company. During the war he served with the Royal Canadian Navy as Lieutenant.

Scancraft Plating, Ltd., a newly incorporated Canadian company, specializes in industrial finishing and treatments, precision electroforming, and deposition of chromium and nickel for wear resistance and build-up. A complete service to engineers is provided for specification work.

Samuel S. Douglas has been appointed as special representative to the iron and steel industry, according to an announcement by Joy Mfg. Co.

Douglas has been a member of the Joy organization as a representative in the Pittsburgh district since 1948. Prior to that time he was vice-president of engineering and sales at the Arms Franklin Corp., Franklin, Pa. He is a native of Oil City, Pa.

Walter H. Prine has been appointed head of the electroplating-chemical-catalyst section of the Nickel Sales department according to an announcement by The International Nickel Company, Inc. He will handle commercial relations with distributors and users of nickel for electroplating, for chemical manufacturers and for catalysts.

Prine

Prine joined International Nickel in 1945 as a member of the plating section of the sales department, working in liaison between the company's research laboratory and the plating field in the development of new uses and the extension of prevailing uses of nickel.

Prior to his association with Inco, Prine served for seven years with the Lamp Division of Electric Auto-Lite Corporation as Chief Chemist in charge of metal finishing and metallurgical processes. He was also engaged in consulting work in metal finishing in the Cincinnati, Ohio, area. During the war he worked on the development of the production and the finishing of steel cartridge cases.

A registered professional engineer, Prine is a member of the American Electroplaters' Society, the Electrochemical Society and the National Association of Corrosion Engineers.

Charles H. Leet, Pittsburgh branch manager since 1949, has been transferred to the firm's larger Chicago office as assistant branch sales manager and **R. L. Kegg,** formerly branch sales engineer at Pittsburgh, succeeds Leet as branch sales manager there, according to an announcement by Exide Division of The Electric Storage Battery Co.

Leet joined Exide in 1938 as a sales engineer with its Pittsburgh branch, and was appointed manager there in August 1949. A Cornell University graduate, he is a member of American Society of Electrical Engineers, Association of Iron and Steel Engineers, and Engineering Society of Western Pennsylvania. Leet also is secretary of Pittsburgh Chapter, American Material Handling Society.

Kegg was employed by Exide in 1951 as a Pittsburgh branch sales engineer. A member of American Material Handling Society, he was graduated from Univer-

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The PERMAG line of cleaning compounds for the electrolytic cleaning process of the plating industry makes possible a solution for every cleaning problem.

With the skill and knowledge developed in over 30 years of service, PERMAG cleaning compounds are designed to provide maximum cleaning efficiency at the lowest possible cost to ease your daily operations and increase production.

PERMAG technical service is also available without obligation to assist you in any unusual or difficult cleaning question you may face. Why not take advantage of it today?

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"Controlled Compounds" in extruded bar and liquid to meet all requirements and conditions of any job.

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Check these features

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- SPRAYABLE VISCOSITY

J. C. Miller Engineers are fully qualified through technical training and years of practical experience to demonstrate and recommend materials and methods for use in your plant — materials and methods that pay you big dividends in higher production and increased savings.

Our Buffing Engineers are equipped with portable Liquimatic demonstration kits which enable them to easily show you the savings that Liquimatic can effect in your plant — on your production line. This demonstration equipment is rapidly set up, requires no assistance from your help and the test can be made on hand lathes or automatic equipment using just a compressed air connection. The demonstration in no way impedes your normal production flow.

Here is a demonstration you should see regardless of past experience or whether or not you are using a liquid compound at present! We know that we can show you that we have achieved the maximum in performance through combining the very latest in automatic application equipment with the very best in compounds — Liquimatic. This is the Liquimatic team — an unbeatable combination.

Send today for your copy of the big, new Liquimatic and Liquimatic Automatic Equipment Brochure. It's full of valuable information for the metal finisher.

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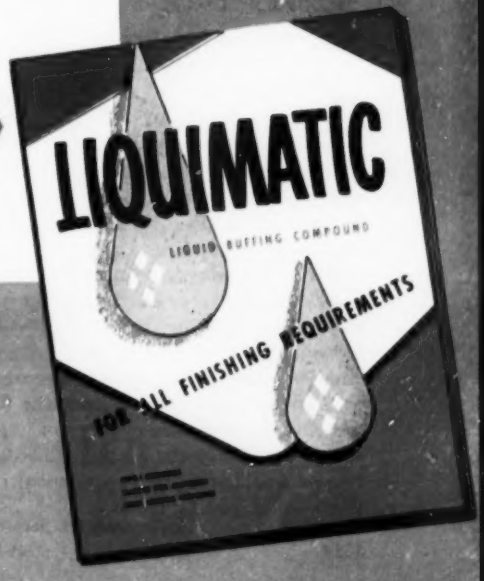
LETS YOUR BUFFS LIVE LONGER



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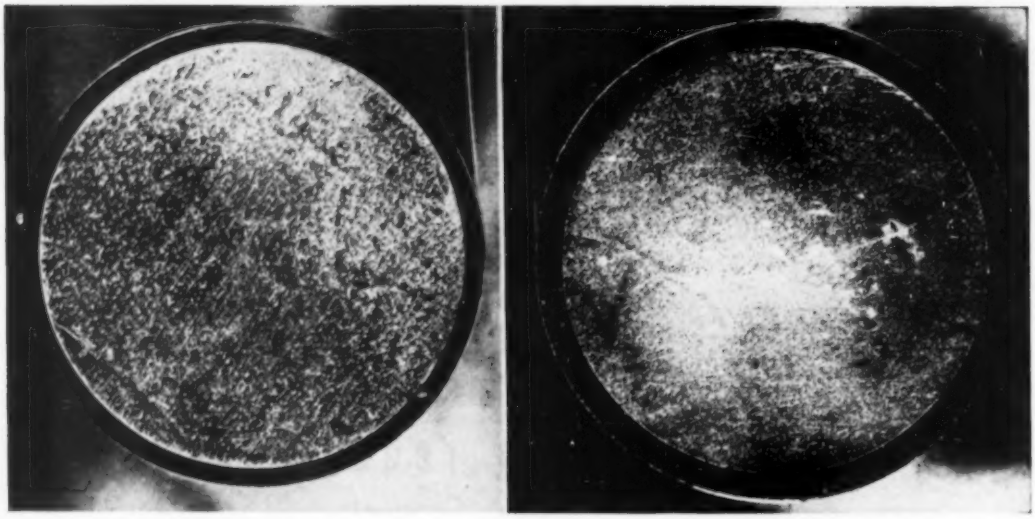
(Advertisement)



Macrograph of chromium plated steel rod, plated in ordinary solution for 16 hours. Deposit built-up to 0.016" on radius.

Identical rod, plated in SRHS Solution, under identical conditions, built-up a 0.0225" deposit on the radius – over 40% more. Such speed cuts cost, increases capacity without extra expense.

Are you taking advantage of these many ways to cut plating expenses?

Savings in time, labor, materials, and equipment are made possible with United Chromium's aid

A LEADER in the fight against high finishing costs is United Chromium which has developed many ways to make plating operations more efficient and profitable.

WAYS TO SAVE IN CHROMIUM PLATING

Chromium plating costs can be cut by *reducing* salts consumption, power needs, lost production time, rejects, and special racking procedures–and by *increasing* plating speed and tank load size.

All these methods of cost reduction are made possible through the features of high-speed self-regulating chromium plating systems developed by United Chromium. Unichrome SRHS Chromium Baths are regularly used for all types of decorative and hard plating. Enthusiastic reports from the field say the SRHS systems not only save money but improve plating quality as well. They cut plating time up to half, minimize misses and burns, use economical concentrations, remain in top plating balance.

WAYS TO SAVE IN COPPER PLATING

Major opportunities for reducing copper plating expense lie in ending or simplifying buffing by depositing a more uniform plate. Reducing the need for treating of the plating wastes can also save. Faster plating helps, too.

New addition agents for use with Unichrome Pyrophosphate Copper have eliminated buffing for many users, made it easier for others who prefer to buff copper rather than the base metal or subsequent deposits. Plating speed has been increased – by as much as 20% in some cases. Costs for waste disposal facilities are also being cut because the bath contains no cyanide.

WAYS TO SAVE ON NICKEL PLATING

Decreasing the rate of chromium rejects due to nickel passivity, reducing downtime for purification of nickel solutions, and using more stable addition agents are important means for lowering bright nickel costs.

Unichrome Bright Nickel was developed especially for these characteristics. In 4 years of actual commercial operations, it has proved that its greater receptivity

for chromium deposits, more stable addition agents, and exceptional tolerance for impurities do cut nickel plating costs. Through its ability to stay on the job, Unichrome Bright Nickel has become known as the "work horse" by plants that previously used other bright nickel processes.

THE WAY TO SAVE ON ANODES

A chromium plating anode lasts longer when its entire surface is active – even that part facing the tank lining. This not only avoids costly corrosion, but also helps improve current distribution, reduce misplates.

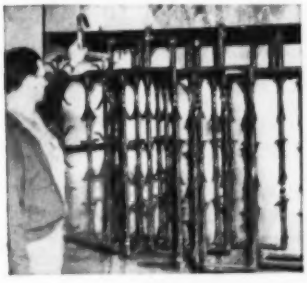
A new development by United Chromium delivers such performance. Unichrome Round Anodes offer greater anode activity and therefore longer, more economical service. With their cylindrical and more rigid design, they can end warpage problems and distribute current better. Fewer anodes can therefore be used.

An innovation in chromium plating anodes – a round shape that provides greater anode activity.

THE WAY TO SAVE ON RACK COATINGS

Plastisol rack coating builds up substantial body and resiliency and offers longest service. Also easier and more economical to apply, it provides a positive means for lowering rack insulation and maintenance costs.

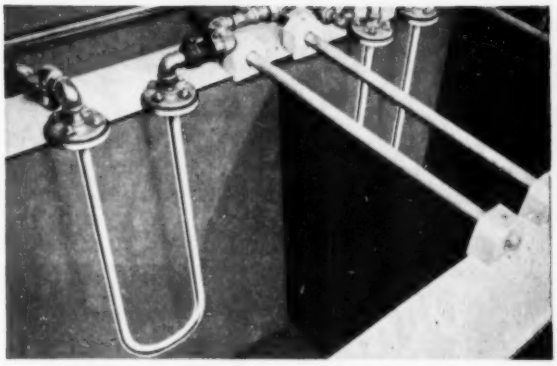
In its many years of use, Unichrome Coating 218X has established a remarkable record for economy. It defies all plating and cleaning solutions, even vapor degreasing cycles. It guards against solution contamination since it contains no harmful ingredients and is formulated not to chip, crack, blister or form pockets.



Large racks ready for heavy duty as they emerge from the baking oven with tough Unichrome Coating 218X protection.

WAYS TO SAVE ON CHROMATE TREATING

Economy in chromate treating comes from using the process best suited to the requirements. Factors to be considered are whether processing will be manual or automatic, size of production, equipment available, and type of finish required.



ECONOMY IN HEATING – A Unichrome Tantalum Heating Coil like the above paid for itself in 6 months by eliminating former downtime and maintenance with lead coil in chromium solution. It will still be paying a bonus years later.

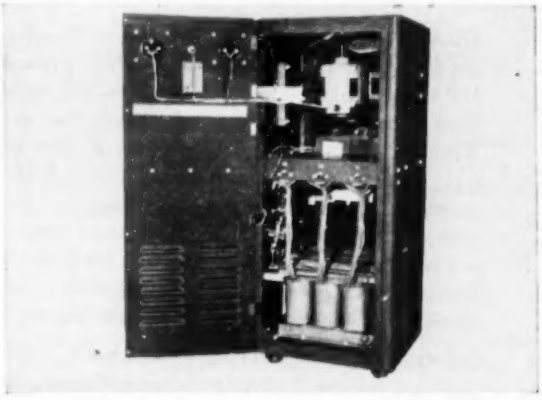
A complete line for treating zinc and cadmium is offered by United Chromium to produce clear, black, olive drab, yellow and even brass colored finishes. Both chemical Unichrome Dip processes and electrochemical Anozinc* processes are available to meet requirements.

Trade Mark

WAYS TO SAVE ON EQUIPMENT

Obviously, getting the *right* equipment for the job is a first requirement. Then comes the right capacity, in order to avoid the economic waste of too much and the production losses of too little. Quality shouldn't be overlooked, either – it means lower cost per year. And finally – an efficient setup of the overall operation.

The line of Unichrome equipment accompanied by United Chromium's experience and technical aid can help you satisfy these requirements. Quotations promptly handled.



Inspection of the interior of a Unichrome Rectifier gives good visual evidence of superior quality.

To get more information and answers to your questions, write your nearest United Chromium office.

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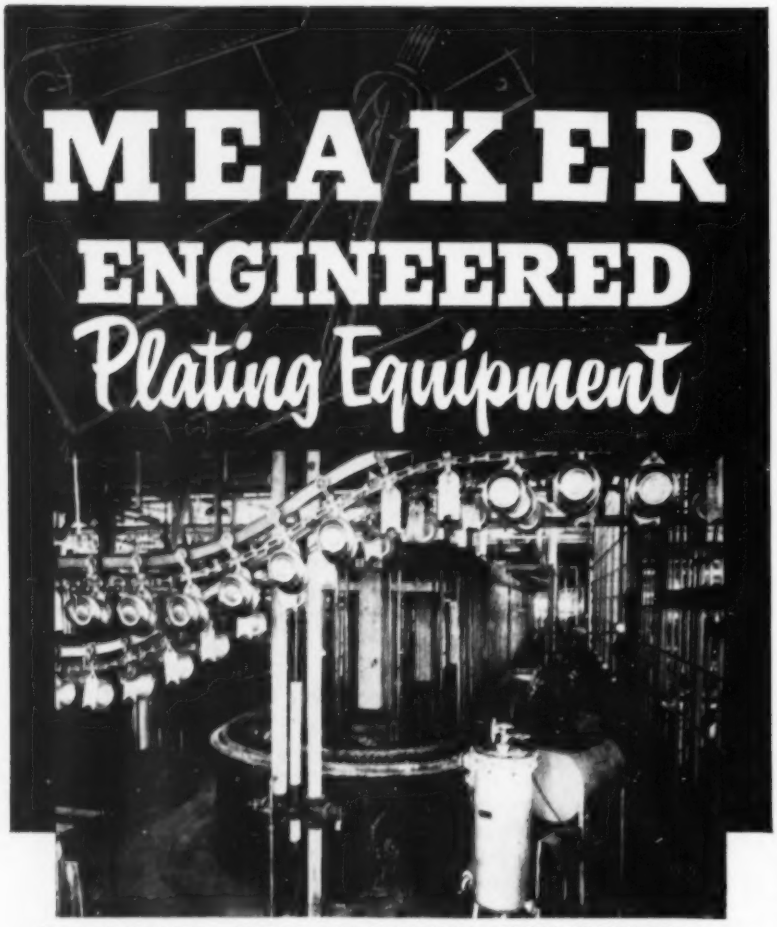

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MEAKER puts engineered efficiency into its line of plating, anodizing, phosphatizing, and other processing equipment. MEAKER engineers will help you determine what specific kind of equipment you need . . . and then see that you get it! Whether you need standard or special, fully automatic or batch type, straight-away or return style, through MEAKER'S recommendations you can be *sure* of getting the ideal installation for your particular process. Many years of experience designing and constructing plating equipment for some of the nation's top industrials has given us the technical ability that assures you the utmost in efficiency—high production plating at low unit cost.

Call or write today and have a MEAKER representative survey your problem with you at no obligation. You may be pleasantly surprised at the results.

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Phone OLympic 2-2110

Personals

Ward W. Minkler, formerly Pacific Coast manager of sales and chemical service, has been named assistant manager of market development of the Titanium Metals Corporation of America. He has assumed his new duties at the general sales office, 233 Broadway, N. Y.

Minkler

Minkler received his Bachelor of Metallurgical Engineering degree from R. P. I. and his Master of Business Administration from Harvard University. Prior to joining Titanium Metals Corporation of America, Minkler was employed by the Babcock & Wilcox Company, Tubular Products Division.

Marc Bendick was elected president of the Barnaby Manufacturing Co., Inc., Bridgeport, Conn. He succeeds **Barnabus Toth,** who has retired.

Bendick

Also elected were **Jack Stock,** treasurer; **Louis F. Kutscher,** sales manager; and **Harold Saunders,** superintendent.

Steve Puschaver has been appointed plant manager; **J. R. Horacek** assistant plant manager; and **John W. Whittleman** personnel manager at the company's Muscle Shoals (Ala.) plant, according to an announcement by **A. H. Ingley,** vice-president of manufacturing of Diamond Alkali Co.

Puschaver is being transferred from the company's Painesville (Ohio) Works, where he was general superintendent of the chlorine plant. He joined Diamond in 1941, the year he received his B.S. degree in chemical engineering from Case Institute of Technology.

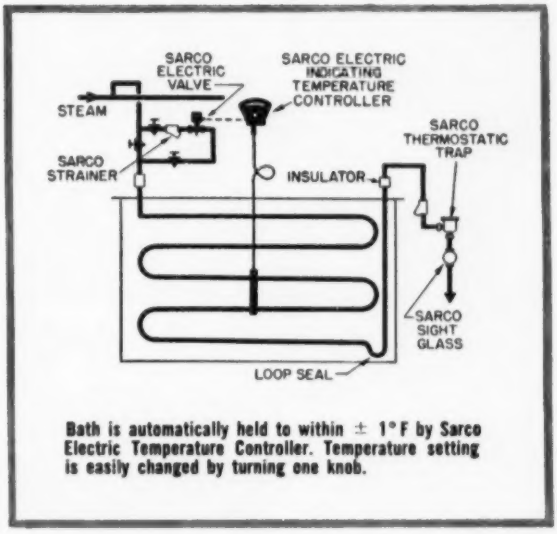
Horacek is also being transferred from the Painesville Works where he was superintendent of Power. He was first employed at Diamond in 1933, where he was

How control of tank temperatures

improves product quality—

cuts operating costs

3 ways



Bath is automatically held to within ± 1°F by Sarco Electric Temperature Controller. Temperature setting is easily changed by turning one knob.

HERE'S HOW! Sarco electric temperature controllers soon pay for themselves by eliminating the inherent wastefulness of manual controls. Completely automatic operation saves plating materials, insures quality control by keeping temperatures where they belong at all times. Your tank-operating costs are cut three ways:

Automatic heating and cooling of solutions by Sarco Electric Temperature Controllers, one of many Sarco installations at Bendix Aviation Corp., Red Bank Division, N. J.

1. **You lower rejects** because solutions are held automatically to plus-minus 1°F. No chance for human error to mess up a tankload . . . and cut into profits.

2. **You save plating solutions** because automatic control prevents boil-off caused by creeping temperaure.

3. **You save steam** because you use only enough to keep bath at proper temperature.

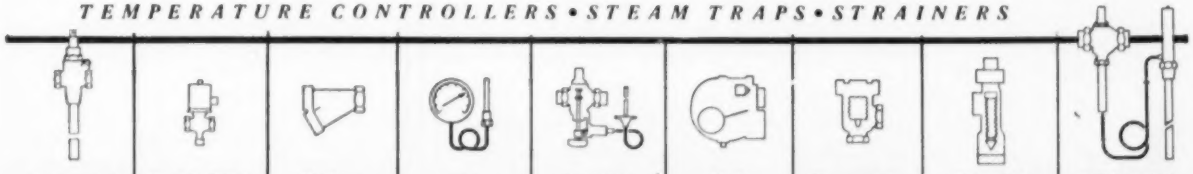
You can equip your tanks with a Sarco Electric Temperature Control System for as little as $130 a tank. Sarco controllers not only hold temperatures automatically but also indicate the temperatures being maintained and are easily adjustable for different jobs.

For complete information on the advantages of Sarco temperature controllers, write for Technical Bulletin No. 6. Sarco Company, Inc., Empire State Building, New York 1, N. Y. Representatives in principal cities.

SARCO

improves product quality and output

TEMPERATURE CONTROLLERS • STEAM TRAPS • STRAINERS



Personals

located at the electric shop. After graduation from Case Institute of Technology in 1937, when he received a B.S. degree in electrical engineering, Horacek was associated with General Electric and Republic Steel. In 1942 he was employed as assistant electrical superintendent at Diamond Magnesium Co. and returned to the Painesville Works when the magnesium plant closed in 1945. He was transferred to the company's Deer Park plant in Houston, Texas, when it was under construction in 1947, and served as utilities engineer and later as utilities superintendent before being transferred back to Painesville in 1951.

Whittleman is being transferred from the company's Houston Deer Park plant where he served as staff assistant in Personnel since May 1953. His previous experience includes employment as Director of Labor Relations of the Rheem Mfg. Co., Houston.

Henry H. Wallace has been appointed to the sales staff of the Apex Alkali Products Company of Philadelphia. Wallace will work out of the Pittsburgh area, handling the Apex line of cleaning compounds and lubricants. A graduate of Washington and Jefferson College, he has over 12 years of experience in the metal field.

Fredric E. Merriman has been appointed sales engineer for the Whitfield Chemical Company, 14225 Schaefer, Detroit, Mich., according to an announcement by **C. Whitfield Smith,** company president. His territory will include parts of Ohio, Pennsylvania and New York.

A native of Hartford, Ohio, Merriman will remain located in that city. He attended Ohio State University.

His appointment is part of an expansion program undertaken to meet the increased demand for Whitfield's specialized metal cleaning, phosphating, and paint stripping chemicals and processes.

Dr. R. C. Gibson has been promoted to assistant vice-president according to an announcement by **R. W. Englehart,** president of Park Rust Proof Company.

Announcement was also made of the promotion of **E. W. Richards,** formerly service manager, to the post of technical director. **R. I. Peterson,** formerly assistant service manager, moves up to the post of service manager.

Robert L. Bell, formerly superintendent of metals, Carboloy Department of General Electric Company, has been appointed manager of manufacturing engineering.

Prior to coming to Carboloy in 1939, Bell was affiliated with Bates & Rogers Construction Company and the Carboloy component of the Cleveland Wire Works.

Rudolf Torbico, formerly associated with Moore-Wright Co., Port Huron, Mich., and previously with Ford and General Motors, has joined the Carboloy Department of General Electric Company, as a field sales representative.

Torbico will make his home in Davenport, Iowa. He holds a B.S. degree in industrial management from the University of Akron, Akron, Ohio.

Wayne J. Streavig and **Harry R. Johnson** have been appointed representatives by the Magnuson Products Corp.

Wayne J. Streavig will operate from Allentown to Baltimore. He is experienced in the metal finishing field, having operated his own plating firm, and he has served as an officer of the AES.

Harry R. Johnson has been assigned to Chicago and surrounding counties. His background includes finishing materials as well as cleaning materials.

Marshall B. Taft has been named general manager of the valve division of Minneapolis-Honeywell Regulator Company. He succeeds **Stephen A. Keller,** who has been named general manager of the new Heiland division of the company in Denver.

Taft, formerly assistant to the president of the firm's industrial division in Philadelphia, will have the responsibility for all phases of the division's activities.

The new general manager joined Honeywell in Chicago, after five years of private law practice, as legal counsel to the firm's aeronautical division. In 1945 he transferred to the industrial division in Philadelphia where, as assistant to the president, he has been responsible for staff operations.

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❶ improve color

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Available in regular 3 to 1 ratio for yellow Brass Plating.

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Suitable for both still tanks and barrels.

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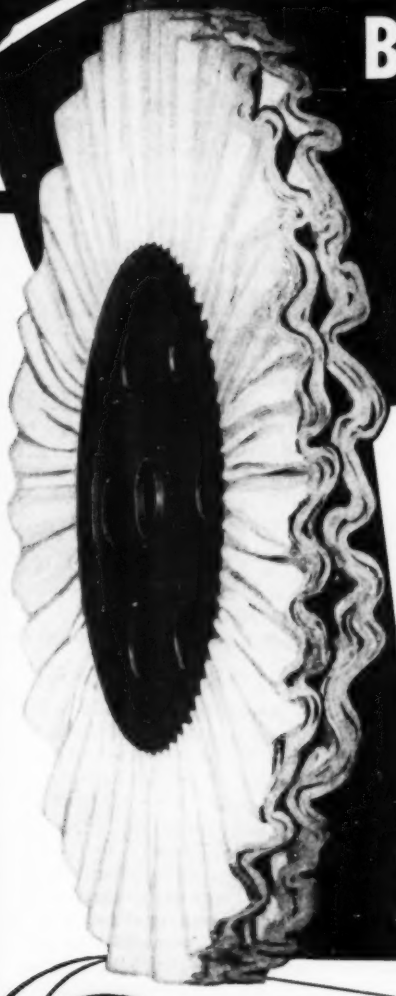
New SCHAFFNER BIAS Buffs

give more mileage ...



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COMPANY _____ STREET _____
CITY _____ ZONE _____ STATE _____

SCHAFFNER AIR-COOLED METAL-CENTER BUFFS ARE PRICED RIGHT • PRODUCED IN ALL DIAMETERS, CENTERS, PLYS AND COUNTS

Trade Literature

L—1200. Polishing and Buffing Lathes Bulletin—A new line of polishing and buffing lathes are features in a bulletin (TP-55) now available from Frederic B. Stevens, Inc., Detroit.

In addition to ten models of constant speed lathes, designed for various operations, this Stevens bulletin also describes four models featuring variable speed operations, available in many instances in optional speed ranges.

A special feature of this new booklet is a comparative chart outlining all standard specifications and important features of each Stevens lathe model in easy-to-read form for ready selection of the right model for any particular job requirement.

Copies of this complete bulletin may be obtained by using the Reader Service Card.

L—1201. Tank Lining Bulletin—A new four-page bulletin that discusses, illustrates, and gives considerable data on the application of flexible Koroseal sheet to plating tanks, racks, and vats has been made available by the MW Protective Coatings Division of Metalweld, Inc.

Typical materials handled include nitric, sulfuric, and chromic acids, bleaches, ammonium hydroxide, barium sulfide, caustic, plating solutions, and many organics. Chief limitations are the chlorinated hydrocarbons and aromatics, gasoline, and similar solvents and acetates.

Typical service is illustrated by a tank with brick sheathing installed in 1945, which has been handling a solution of 10 per cent nitric and 2 per cent hydrofluoric acid at a temperature of 180° F. Linings can be applied in thicknesses up to 3/16 inch and are easy to repair if damaged. This material does not absorb liquids being handled and can be used for a different liquid after rinsing. Write for free copy of bulletin, using Reader Service Card.

L—1202. Du Pont Booklet—America's industrial system, if allowed to progress unhampered, can provide a quarter again as many jobs by 1975 as it does now. This was the conclusion reached in "The Story of Employment Opportunities," a new booklet published by the Du Pont Company today.

"It is a system," the booklet says, "that by 1975, assuming no catastrophe intervenes, can bring 23 million more industrial jobs, and a national total of some 80 million. These can be better jobs, with increased purchasing power, shorter working hours, and a higher living standard."

The 32-page illustrated booklet points out that "tomorrow's 'help-wanted' advertisement is being written by the research of today. . . . If research were ever stopped, we might see the end of a system which already has brought this nation to a point where 17 million are employed in manufacturing industries, and more than 60 million in the nation's civilian economy."

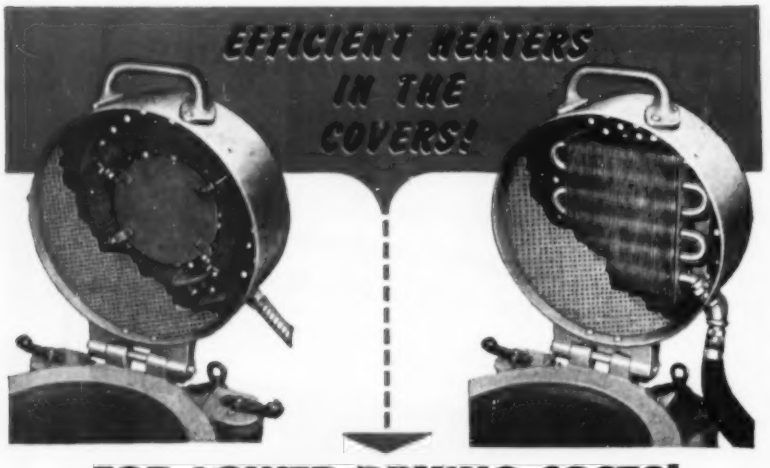
For a copy, use Reader Service Card.

L—1203. New General Catalog—A new 12-page general catalog with illustrations, descriptions, and basic specifications of Fischer & Porter Company's complete line of process instrumentation is now available. Instrumentation for measuring and controlling process variables includes: variable-area and variable-head flow meters; pressure instruments; temperature instruments; liquid level instruments; density and specific gravity measuring instruments; viscosity and consistency instruments; electric, pneumatic, and electronic transmitting, recording and controlling instruments with alarms and integrators; and air-operated control valves in various models and construction materials.

This general catalog may be secured by using Reader Service Card.

L—1204. Grinding Wheel Catalogue—A new condensed catalogue of the most widely used grinding wheels carried in stock has just been published by Norton Company. A feature of the catalogue is the supplement of net prices to the customer in various quantity lots. Net pricing was introduced in the abrasive industry by Norton earlier this year.

This 28-page illustrated booklet covers the subject of grinding wheel selection in considerable detail. Points covered include abrasive types, bonding materials, wheel speeds, wheel markings, standard



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As optional equipment with any Nobles Centrifugal Dryer, you may have efficient steam or electric heaters safely and compactly mounted in the cover. Heat doesn't come from an auxiliary unit and transfer through pipes . . . it saves space, saves heat.

It's only one of many features you'll like about this machine of advanced design. It's completely different in principle. The old way was to *blow* air down at the parts. A powerful suction fan *draws* the air from the bottom of the modern Nobles Dryer. Fresh air rushes in from the top to fill the vacuum, is drawn evenly through the entire contents and exhausted at the bottom.

You'll like its extra weight, its smoothness, its freedom from vibration. As one user put it, "Certainly it depreciates less and requires less maintenance than any competitive product."

In the interest of lower drying costs, write for more information today!

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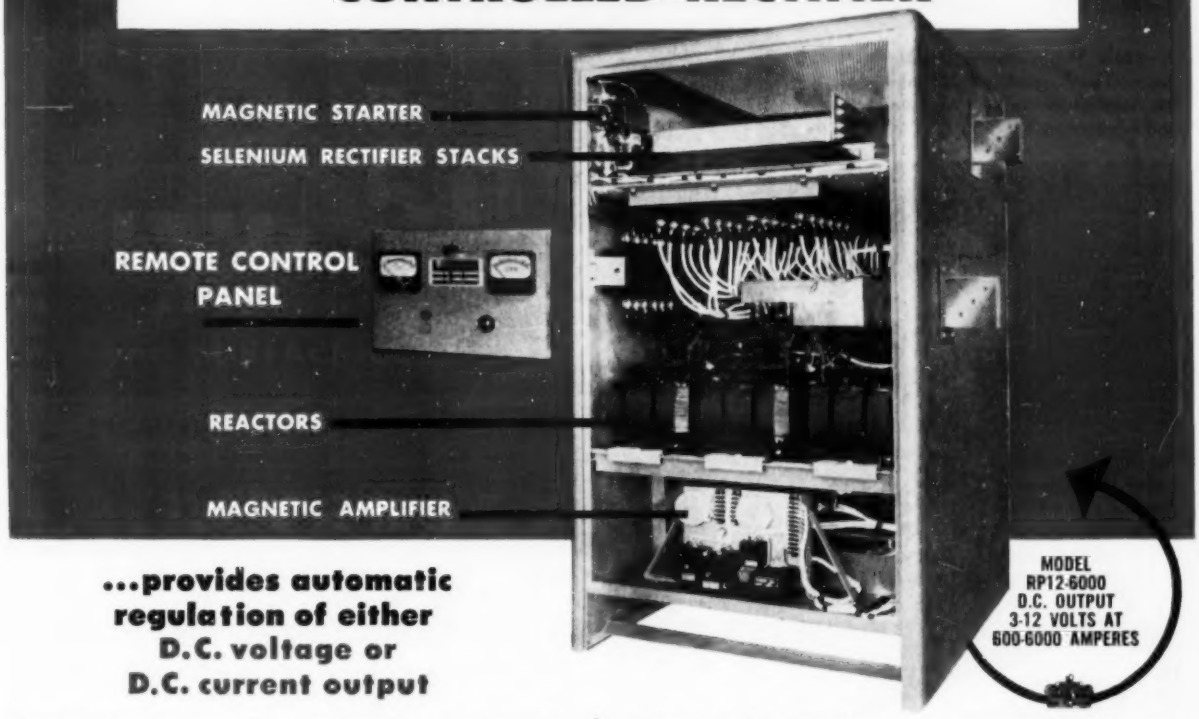
Write Today for the FREE NOBLES-DRYER BROCHURE

Crown MAGNETIC AMPLIFIER CONTROLLED RECTIFIER



...provides automatic regulation of either D.C. voltage or D.C. current output

Simply set the manual selector switch to the type of regulation desired (voltage or current stabilization), and with the manual output control knob, located in the remote control cabinet, smoothly adjust to the desired output value, and your Crown Magnetic Amplifier Regulated Rectifier will maintain DC output at its preset value, regardless of varying load conditions and line voltage fluctuations throughout the treatment time.

For processes requiring constant voltage control, such as decorative chrome plating, anodizing applications, conditions where constant variations in tank loads occur, etc., you will find the automatic voltage stabilization feature highly effective.

For processes such as hard chrome plating, precious metal plating, hard anodizing, etc., requiring DC current density* to be maintained at a constant value, the automatic current stabilization feature will prove highly desirable.

Like all Crown Rectifiers and Controls the MAGNETIC AMPLIFIER** CONTROLLED RECTIFIER has been thoroughly engineered for trouble-free performance, ruggedly built for extra long life and will efficiently deliver dependable DC power under the most severe operating conditions.

* Upper current limiting is recommended where there is a danger of excessive loads being placed in the tank. It prevents the unit being operated at more than its rated output.

** Magnetic Amplifier Controls have no electronic tubes, powerstats or tap switches. Simple in design (the only moving part is the cooling fan), they require a minimum of maintenance.

For more specific and technical information concerning your application, write Crown Chemical and Engineering Co. today... or contact your nearest authorized distributor.

Crown SELENIUM RECTIFIERS

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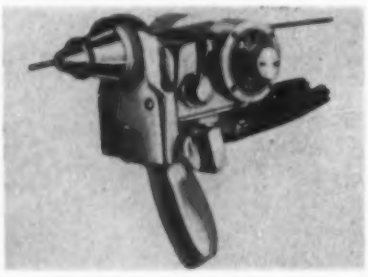
...rade Literature

wheel shapes, mounted points, and abrasive polishing grain.

Wheel specifications for hundreds of common applications given in easy to use tables serve as a ready guide for wheel selection. Known as catalogue 1052, this new booklet may be obtained by using the Reader Service Card.

L—1205. Mogul Turbo-Jet Metalizing Gun—The Metalizing Company of America, manufacturers of metal spray guns and equipment, have recently announced



the new Turbo-Jet metalizing gun. It is stated that this new model is so flexible that one gun will take care of all spraying operations, making it ideal for production, maintenance, and anticorrosion spraying applications. The gun may be used in a tool post or hand operated and weighs only 5½ pounds.

The Turbo-Jet has been designed to spray an extremely fine, dense coating using wire from 20 gauge to 3/16 inch diameter from the highest melting point molybdenum to the lowest melting point wires. It is a general purpose gun, used to spray both hard and soft metals, and it is not necessary to change worms, gears, or feed rolls. Dual feed rolls individually driven eliminate any possibility of wire slippage through the gun and provide a more positive feed.

For illustrated literature, use Reader Service Card.

L—1206. Permutit Pressure Filters—A comprehensive bulletin, No. 2225B, describing Permutit's extensive line of pressure filters and their accessories has been made available. These filters are now being used to remove suspended solids such as dirt, turbidity, iron, oil, and color.

Prepared by the Permutit Company, makers of ion exchange resins and water conditioning equipment, the bulletin should be of interest to all engineers dealing with water problems. Specifications, operating characteristics, outline dimensions, and typical installation photographs have been included in this revised edition.

Get a copy of Bulletin No. 2225B by using Reader Service Card.

L—1207. New Optical Straightedge Simplifies Measurement of Small Surfaces—A beam of light, interrupted by the inscribed reticle of a precision "feeler" microscope, measures deviations

as small as 0.000025 inch on flat surfaces up to 20-inches long, in the Griswold Hoet Optical Straightedge. Previously available only in five or ten foot lengths, the new 20-inch model brings the ease and accuracy of this measuring method to small scale machining or polishing operations.

A prism-and-lens housing, resting on two metal blocks over the work, permits the feeler microscope with its built-in illumination to ride along the surface under examination. Deviations observed through the microscope are indicated by the relative position of two indices and

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WITH THESE TWO GREAT CLEANERS!

DIVERSEY
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ELECTROCLEANER and SURFACE CONDITIONER

ELIMINATE BLISTERING AND STREAKING

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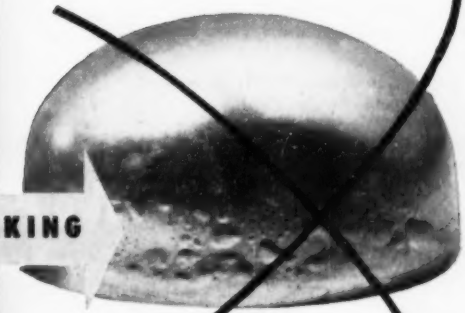

Rejected Electroplated Zinc Base Die Casting

You can depend on Diversey No. 505 and No. 909 to help you produce bright, blemish-free, adherent surfaces on zinc base die castings . . . prevent blistering and streaking caused by insufficient cleaning.

Diversey No. 909 is an unique heavy duty soak tank cleaner . . . non-caustic yet exceptionally powerful . . . can eliminate solvent presoak operation . . . now *one* precleaning step instead of two . . . saves time and money . . . cleans thoroughly, safely!

Diversey No. 505 is an amazing electrocleaner and surface conditioner made especially for cleaning zinc base die castings . . . cleans thoroughly and prevents redeposit of soil on work . . . conditions the surface, providing better adhesion between electro-plate and base metal!

Start now to profit from efficient, economical, carefree cleaning! WRITE FOR *Free* BULLETINS ON DIVERSEY No. 505 AND DIVERSEY No. 909!

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FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 1631.

Trade Literature

are converted into linear measurement by easy reference to a micrometer thimble. Illustrated literature is available by using Reader Service Card.

L—1208. Measuring and Control Equipment—To illustrate various types of control and measuring equipment, a 4-page flyer, Bulletin 050, has been prepared by the Simplex Valve & Meter Company. General information is contained on both primary and secondary measuring devices.

Included are short descriptions and characteristics of standard and elliptical Venturi tubes, as well as parabolic flumes used as primary devices to actuate secondary indicating, recording, and totalizing units.

A copy of Bulletin 050 may be secured by using Reader Service Card.

L—1209. Wyandotte Chemicals Offers Paint Stripper Application Chart—An application chart for paint strippers is now available.

Listed on this chart—enlarged reproduction of which is shown in the photo—are the following headings—"Type, Used On, How Used, Features and When To Use."

Detailed directions for the four Wyandotte paint strippers listed on the chart, as well as data on metal cleaners and related products, are also available.

You can obtain a copy by using the Reader Service Card.

L—1213. Bulletin on Electroplating Processes—Hanson-Van Winkle-Munning Company offers a new four-page two-color bulletin on its electroplating processes.

The bulletin describes and lists key characteristics of sixteen processes. These include seven nickel plating, three zinc, one cadmium, one copper with and without periodic reverse current, two silver, one lead, and one bright ternary alloy plating process.

Included in the bulletin is a list of ten services available to H-VW-M customers. Readers may find out in this section what provisions H-VW-M has made for its customers to train platers, test processes and equipment, and advise on setting up and sequencing metal finishing operations.

To get bulletin P-100, use Reader Service Card.

L—1214. New Bulletin on Centrifugal Pumps—Industrial Filter & Pump Manufacturing Company, Chicago, has issued a new eight-page bulletin on their line of vulcanized-rubber-lined centrifugal pumps and stainless steel and cast steel centrifugal pumps. Besides giving detail specifications and describing the design and construction features which, the company claims, offer superior performance, this bulletin includes performance curves for the various models.

For your copy, use Reader Service Card.

L—1215. Jelco Offers Reference Bulletin—A new bulletin has been completed by Jelco Finishing Equipment Corp., which lists the entire line of metal finishing and plating equipment and specialties for easy reference. On the back page is a selection of data which comes into everyday use in a plating shop. This data is not usually available in most literature. For example, one of the tables lists the amount of alkali cyanide needed to dissolve various salts in making up a cyanide bath.

Jelco's products of research are included and are worthwhile for the plater to investigate.

All interested may have a copy; use Reader Service Card.

L—1216. Electronic Measuring Instruments Bulletin—A new edition of General Bulletin No. 100, which contains a description of the company's complete manufacturing program of photoelectric and electronic measuring instruments, has been published by Photovolt Corporation. The new edition comprises a number of recently developed items, particularly *p*H meters. For a free copy, use Reader Service Card.

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the Perfect Combination

FROM START TO FINISH

ZIPPO CLOTH BUFFS

These famous long-wearing buffs run cool under all buffing conditions. High count bias-cut cloth is assembled on ventilated steel centers. Each section is perfectly balanced and faced—requires no raking.

BUFFING COMPOUNDS

Formax produces a complete line of buffing compounds in bar, tube and liquid form.

Our extensive manufacturing, laboratory and testing facilities are at your disposal.

ZIPPO SISAL BUFFS

You have a pleasant surprise coming if you haven't tried the new Zippo bias-type sisal buff. It was specifically developed for steel buffing—to blend polishing grit lines—to cut down stainless steel—and bring up a bright lustre.

Other Formax products include the well-known C-20 Flexible Contact Wheels and F-26 Abrasive Belt Grease Stick.

Descriptive Catalogs Sent on Request

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"THE FOUR McALEERS"

RESEARCH

MORE FACTS—ABOUT THE AES RESEARCH PROGRAM

"Research for a Better Tomorrow"

The well-known research scientist, Mr. Charles Kettering, said in one of his talks:

> "Research is a high-hat word that scares a lot of people. It needn't. It is rather simple. Essentially, it is nothing but a state of mind—a friendly, welcoming attitude toward change. Going out to look for a change instead of waiting for it to come. Research, for practical men, is an effort to do things better and not to be caught asleep at the switch. The research state of mind can apply to anything—personal affairs or any kind of business, big or little. It is the problem-solving mind as contrasted with the let-well-enough-alone mind. It is the composer mind instead of the fiddler mind. It is the 'tomorrow' mind instead of the 'yesterday' mind."

When you support the AES Research program today, you invest in a better tomorrow for electroplating.

Join as a Sustaining Member, Today.

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INVEST NOW!!!

"YOUR BEST BET'S THE AES RESEARCH PROGRAM"

Equipment and Supplies

E—1217. New Chromate Protective Film Does Not Dull Galvanizing—Pronat Division, Poor & Company, announces a new chromate treatment for hot dip galvanized surfaces. The material identified as Proseal D-36 is said to give good resistance to the formation of white corrosion products without discoloring galvanized surfaces.

The following results were noted where Proseal D-36 was applied to hot dip galvanized sheet in continuous mill operations: a minimum of zinc dilution was evidenced, there was no discoloration of the surface, and treated surfaces resist corrosion in pack test.

A red liquid, Pronat D-36 is packed in 12-gallon carboys. In use, its life is sufficiently long to eliminate the desirability of analytical control.

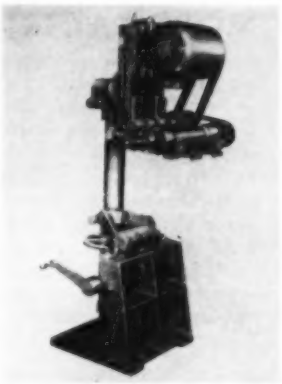
For further information use the Reader Service Card.

E—1218. New Bright Copper Process—Jelco Finishing Equipment Corporation, New York, has announced the addition of a new brightener to an expanding line of research products. It is called Cop-Brite and is used both in still and barrel plating solutions.

It is claimed that this liquid brightener will produce a highly reflective, softer, smoother finish. In order to extend the current density range, an agitated bath is preferred, but brightness is also obtained in a nonagitated bath. Cop-Brite permits flexibility of operation and greater economy.

For more detailed information, use Reader Service Card.

E—1219. Hammond Adds New Floating Head—Hammond of Kalamazoo has recently added another polishing-buffing head and stand unit to their wide line of finishing machinery, which is designated the Model 50-99.



The 50-99 Head has a maximum float action of 4 inches, allowing the head to follow the surface of irregular parts. Flat surfaces can also be finished without using the floating action. Power wheel feed can be furnished, which enables the machine operator to maintain correct pressure, assuring uniform results.

Like all other Hammond polishing and buffing heads, the 50-99 is equipped with an ammeter as standard equipment. Periodic reading of the ammeter takes the guesswork out of the work the head is doing. Thus uniform results are assured.

For additional information, use Reader Service Card.

E—1220. Spray Washer Developed by Detrex—An entirely new concept in spray washers has been developed by the Detrex Corporation of Detroit.

W. F. Newbery, director of sales for Detrex, announced that the new Series 30, Standard Unit, Monorail-Type Spray Washer is the first washer that can be used as a single unit or combined on the premises into a multistate washer to suit the needs of the user without expensive alterations or assembly problems.

Units can be assembled on the premises, either by bolting or welding, and offer a wide variety of combinations. A range of sizes from a spray length of 4 feet up through 10 feet in two-foot steps is available. Each washer unit, set up for gasketing, will accommodate work up to 30 inches wide—with the additional convenience of removable baffles to reduce width where operating economy calls for a narrower opening. Seven different heights are available in the washer openings:

NOW! GET 10% TO 15% MORE ANODE MILEAGE WITH . . .

NEW ANACONDA

"PLUS-4" ANODES*

(PHOSPHORIZED COPPER)

+ 1 Freedom from anode sludge—no "bagging" or diaphragms required.

+ 2 No copper build-up in solution.

+ 3 Exceptionally smooth, heavy cathode deposits.

+ 4 10% to 15% more cathode deposits per pound of anode.

It has been discovered that carefully controlled amounts of phosphorus, together with minute amounts of other elements in electrolytic copper, make anodes of vastly superior quality for acid plating. ANACONDA "PLUS-4" Anodes are available in all the standard sizes and forms at no increase in cost over ordinary anodes. Look for the stamp "PLUS-4" on the anodes you buy.

We'll be glad to supply additional information, in detail, without obligation. Just write to: The American Brass Company, Waterbury 20, Connecticut. 5416S

*For use under Patent No. 2,689,216

ANACONDA® "PLUS-4" ANODES made by THE AMERICAN BRASS COMPANY

BUY UDYLITE'S LONG EXPERIENCE IN BARREL PLATING APPLICATIONS

GET THE EQUIPMENT THAT IS TAILORED TO YOUR SHOP PRODUCTION

Since 1936 when Udylite introduced the first standardized plating barrel with interchangeable parts, it has been on the move through research, engineering and production.

Through these 18 years the Udylite Barrel Plater has progressed with hard rubber, bakelite, melamine and lucite and now the latest development, Tempron. Over 8,000 barrels have been put into customer use.

Each new material, every new engineering detail and every planned operation in this never ending parade of progress has been long studied and operation tested for months before offering to industry.

All Udylite Barrel Equipment is engineered, manufactured and customer plant planned in complete coordination with Udylite Electrical Engineers and Laboratory Technicians.

Regardless of the size of the installation or the equipment involved, Udylite experience and coordinated know-how are always the plus values of incalculable worth—and they are free.

You owe it to yourself—when you have small parts plating problems—to consult Udylite.

Write for Bill Jackson's article "Horizontal Plating Barrels and Auxiliary Equipment."

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DETROIT 11, MICHIGAN

WORLD'S LARGEST PLATING SUPPLIER

Steel parts for electric meters, after forming and annealing, are acid-cleaned and pickled in Pennsalt PM-90. Scale, rust, oils and shop dirt are completely removed. They then have a chemically clean surface for quality electroplating.

"For better pickling and a superior plated finish"

. . . meter maker switches to Pennsalt inhibited pickling agent PM-90

This plant, manufacturing electric meters, formerly used hydrochloric acid for descaling annealed steel parts. Today they have switched to Pennsalt's new PM-90, and report "it gives better descaling and a superior quality finish at no extra cost."

Their cleaning cycle: Degrease . . . alkali clean . . . cold rinse . . . pickle in PM-90 . . . rinse. Parts range in size from very small to quite large and after cleaning are plated with cadmium, or copper and nickel.

In plants everywhere, metal processors are finding that Pennsalt PM-90 saves time and labor, gives smoother, brighter finishes. It is easy to use, is free-rinsing and economical. As the usual acid losses are minimized, PM-90 outlasts raw acid. It does not burn or pit metal. There is no fume hazard. Use PM-90 for production-line pickling of steel, and for removing mill scale, annealing scale and rust.

For full information about PM-90®, or for data on the long and varied line of Pennsalt metal-cleaning products, write to Metal Processing Dept., Pennsylvania Salt Mfg. Company. EAST: 885 Widener Bldg., Philadelphia 7, Pa., WEST: Woolsey Bldg., 2168 Shattuck Ave., Berkeley 4, Calif.

Pennsalt Chemicals

A BETTER START FOR YOUR FINISH

ATTENTION JOB PLATERS AND FINISHERS!

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Pennsalt now provides *direct local* distribution in many areas in addition to their large staff of sales-service engineers and technical service men. The exclusive Pennsalt distributors listed below offer you qualified sales-service on Pennsalt Cleaners *plus* prompt delivery of materials from *local warehouse stocks, in these areas:*

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BUFFALO—ERIE—WARREN
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975-981 Niagara Street
Buffalo 13, New York

CLEVELAND—AKRON—YOUNGSTOWN
General Supply Co.
5317 St. Clair Avenue
Cleveland 3, Ohio

CINCINNATI, OHIO
Herbert Chemical Company
Vine Street & Murray Road
St. Bernard

BALTIMORE, MARYLAND
Hughes Chemical Co.
1411 Fleet Street

MUSKEGON—GRAND RAPIDS
M C Supply
2410 Lake Avenue
N. Muskegon, Mich.

READING—PHILADELPHIA—DELAWARE
Textile Chemical Co.
Second & Spruce Sts.
Reading, Pennsylvania

CHICAGO, ILLINOIS
Joseph Turner Company
435 N. Michigan Ave.

INDIANAPOLIS—RICHMOND—NEW ALBANY
Ulrich Chemical Co.
31 E. Georgia Street
Indianapolis, Indiana

WISCONSIN—ROCKFORD—TWIN CITY
J. H. Schneider Co.
4858 N. Berkeley Blvd.
Whitefish Bay, Wisconsin

Contact your local distributor directly or write: Metal Processing Department, Pennsylvania Salt Manufacturing Co., 861 Widener Building, Philadelphia, Pa.

NEWS OF PENNSALT PRODUCTS

Equipment and Supplies

From 24 inches upward in 6-inch steps to the maximum height of 60 inches. The user also can vary the silhouette with synthetic rubber curtains that protect against overspray and aeration.

Newbery stated that careful engineering and manufacturing have effected substantial price reductions without sacrificing any features essential to good operation and ease of maintenance.

For further details, use Reader Service Card.

E—1221. Direct Measurements Possible on Uneven Surfaces—A new direct measuring, erect image microscope has been announced by the Edmund Scientific Corporation. Mounted on an industrial-type base, the new instrument allows much greater flexibility in use than the unmounted pocket comparator.

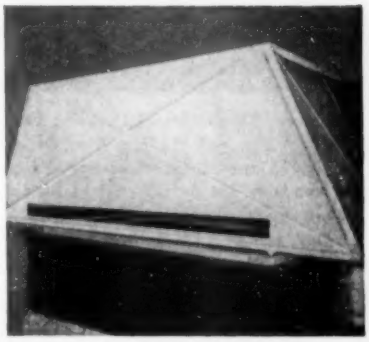
The direct measuring microscope is used to obtain accurate readings of dimensions, radii, angles, and holes. Linear dimensions are given both in decimal inches and millimeters.

It can be used where normal contact measuring devices will not reach or are impractical to use. For instance, it can be used to read dimensions in deep holes, or where obstructions do not permit the free use of normal measuring devices. Also, it requires no mechanical adjustment which would possibly distort the true dimension or distance. Thus, it is ideal for measuring rubber, soft plastics, and other flexible materials, diamonds, assembled mechanisms, liquid spots or deposits, surface irregularities, mesh sizes, grain sizes, vegetable or animal matter, and numerous other materials and items.

Direct linear measurements may be taken up to ½ inch in units of 0.005 inch. Working distance between objective and object being examined is 5½ inches.

For further information, use Reader Service Card.

THIS PLA-TANK® HOOD SAVED ITS COST IN A YEAR



The PLA-TANK Hood shown above has been in continuous use at General Electric's small aircraft engine department in West Lynn, Mass., for over a year. Reports indicate that it is still as good as when originally installed, is already credited with saving its entire cost since no previously used material had lasted over a year.

The tank is used for etching stainless steel billets; solutions used are aqua regia at room temperature and a 50% solution of muriatic acid at 180°F. PLA-TANK has successfully withstood these fumes, where other materials failed.

PLA-TANK products are daily solving problems of all types in the chemical and electroplating fields. They replace or outlast stainless steel, lead and ceramic linings, plywood coated with corrosion preventatives, phenolic plastics and asbestos cement board structures in many applications.

PLA-TANK, molded from long-life, resin-bonded glass fibre laminate, is now resistant to a wider variety of fumes and temperatures than ever before. PLA-TANK is light weight, easy to install, competitively priced.

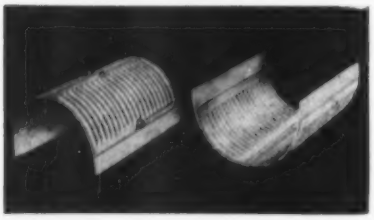
Let us help you solve your problems the modern way — with PLA-TANK. Write today for free data sheets.

P 21

THE Chemical CORPORATION
57 Waltham Ave., Springfield 9, Mass.

Equipment and Supplies

E—1222. Special Shaped Thermo-Panels Announced—Curved Thermo-Panels solve many unusual heat exchange



problems. Thermo-Panel Division, Dean Products, Inc., 616 Franklin Ave., Brooklyn, N. Y., announces that Thermo-Panels are available not only in flat plates but also in special shapes.

With this type of Thermo-Panel it is possible to place these around tanks and under troughs. Thermo-Panels are also incorporated in the construction of tanks, vats, and kettles, where they are used as part of the structural elements of the vessels. They are easier to install and clean than pipe coils.

Thermo-Panels are also available in special shapes such as L's and cylinders and in a wide range of materials, including steel, stainless steel, Monel, and other special alloys.

Complete details and price list may be obtained by using Reader Service Card.

E—1223. Catalyst Gun May Open New Vistas— A completely new field of spray finishing is expected to be opened with the marketing of the DeVilbiss catalyst spray gun.

D. J. Peeps, engineering vice-president of the spray painting equipment manufacturer, said creation of the new gun is expected to speed resin development and formulations which have been retarded because proper application equipment was lacking.

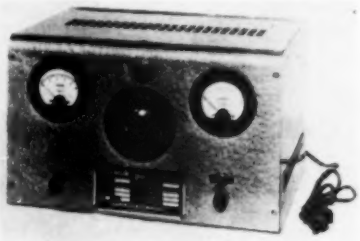
Designed to spray simultaneously plastic resin and catalyst, the new DeVilbiss gun is claimed to be the only one made which will assure a uniform mixture of resin and catalyst.

The gun has been used successfully to prepare the surface of a glass fibre reinforced plastic automobile body and is being used to spray hospital and laboratory table tops by a number of companies who are conducting development research programs to advance formulations.

As formulations progress, the gun is expected to find wide usage.

Further information about the gun, prices, and delivery may be obtained by using Reader Service Card.

E—1224. A New, Low-Cost Bench Selenium Rectifier—is announced by Rapid Electric Company. The rectifier has continuously variable output control ranging from zero to full rated power.

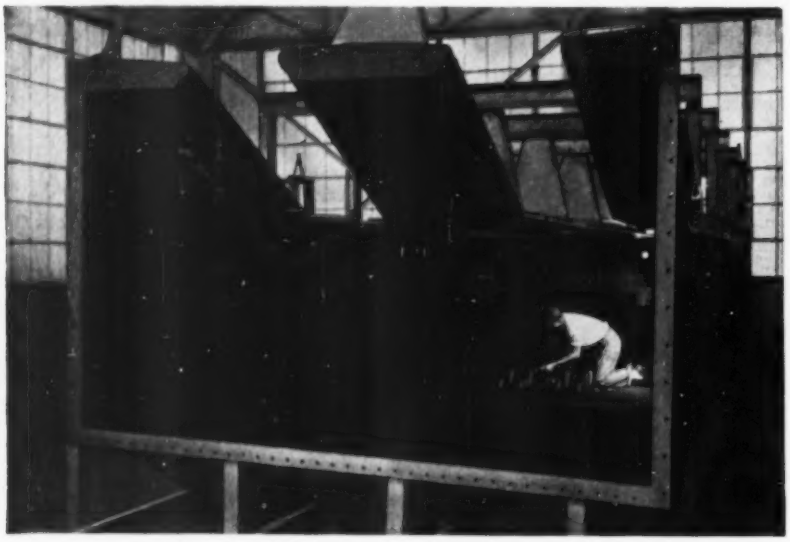


Designated Model 1020F, the full wave design unit operates on an input of 110-120 volts, single phase, 60 cycle ac; with a rated output of 20 amperes 0-10 volts, dc. An inductive capacitive filter provides an output with less than 5 per cent ripple. Designed for extra heavy duty, continuous (24 hour) operation is possible; and provision is made for 20 per cent overload for 2 hour periods.

Model 1020F is furnished complete with 2 per cent F. S. accuracy volt and ammeter, pilot light, starting switch, and fuse overload controls; and is fully guaranteed for one year. A low cost unit, the full list price is $115.00, and immediate delivery can be made from stock.

Rapid Electric Company also manufactures a complete line of rectifiers from 3 amperes to 16,000 amperes d-c output. Units with higher rating are manufactured to meet customer specifications. A data sheet is available and can be obtained by using the Reader Service Card.

E—1225. Water Heater Control Developed—A new "glamorized" water heater control, specially designed for mounting outside the water heater shell yet thin enough for easy concealment, has been developed by Robertshaw-Fulton Controls Company.



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For pickling and metal plating . . . wherever corrosive acids and other chemicals are used, manufacturers specify Manhattan Rubber Linings. That's because Manhattan's more than 60 years' engineering experience has resulted in the most dependable and most economical rubber linings made in the industry today. Manhattan Rubber Linings are made of calendered sheets of non-porous natural or synthetic rubber in required thickness and compounded to eliminate contamination, corrosion, and stray currents . . . to give longer, better service under severest conditions of use. Manhattan's exclusive rubber-to-metal bond eliminates cracking by contraction and expansion due to temperature changes. To detect any imperfections, all Manhattan Rubber Lined equipment is tested dielectrically under 15,000 volts before shipment to doubly assure satisfactory results.

RM-442

RUBBER LINING PLANTS AT PASSAIC, N. J. AND NORTH CHARLESTON, S. C.

MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Manufacturers of Mechanical Rubber Products • Rubber Covered Equipment • Radiator Hose
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FOR INDUSTRIAL COATING!

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3 The strength, toughness, scuff- and abrasion-resistance of MICCROSOL give your coatings longer life.
4 The permanent flexibility and positive, continuous adhesion of MICCROSOL enable them to meet the strictest specifications and technical requirements, for protective coatings.
5 They can depend on MICCROSOL to keep their reputations, and the quality of their work, at the highest level in the industry.
6 They have helped us develop MICCROSOL to its present point of perfection.
7 MICCROSOL is easier to apply. Gives you better coatings for less money.
8 MICCROSOL responds to their skill and experience. Helps them give you the rugged coatings you need to protect work and your equipment.
9 MICCROSOL coatings last longer.
10 They can depend on MICCROSOL!

You can't blame us for being proud of the quality of the coating work produced by our customers. We have worked with them, and for them, to the very best of our ability, during the phenomenal growth of the coating industry. We know them well, and appreciate their loyalty and support. And we hope to have the privilege of serving them all for many years to come.

There's a MICCROSOL Coater located in your vicinity. He's undoubtedly the leader in his field. If you want superior coating jobs, we'll be glad to help you get in touch with him!

It's Tops!

Developed and Manufactured by Experienced Platers

MICCRO Products

MICHIGAN CHROME *and Chemical Company*

8615 Grinnell Avenue • Detroit 13, Michigan

Equipment and Supplies

The new control is shaped much like a cigarette case for ease of installation and concealment.

While drastically different in size and appearance, the control retains standard field-proved components of the company's widely used "Unitrols" and has been designated the "Unitrol 200." It is suitable for all gases.

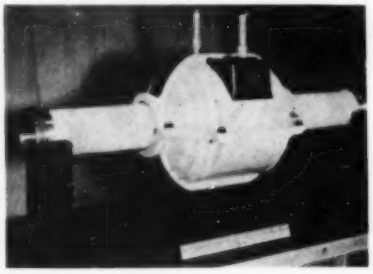
For further information, use Reader Service Card.

E—1226. New Cold Cleaners Improve Plant Safety—To replace highly volatile solvent cleaners in still tanks on the production line, a new combination cold cleaner is offered by E. F. Houghton and Company. Plant safety is increased by eliminating this fire hazard.

Other advantages claimed for this room temperature, water-emulsion cleaning combination of Houghto-Clean 402-403 are: thorough removal of most generally encountered shop soil; protection of freshly cleaned surfaces from rusting between operations or in temporary indoor storage; elimination of heating system costs; and improved working conditions by the elimination of steamy, uncomfortable atmospheric conditions associated with hot alkaline cleaning methods.

For complete details, use Reader Service Card.

E—1227. Magnetic Meter Handles Larger Lines, Unlimited Flows—A new electromagnetic flow meter, designed for 2 to 8 inch flow lines, has been introduced



by the Foxboro Company. Incorporating all the unique advantages of electromagnetic metering, the instrument is additionally rated for unlimited maximum flows, making practical a number of flow measurement applications impossible with ordinary metering equipment.

The Foxboro Magnetic Flow Meter will measure the volume flow rate of any liquid of sufficient conductance and velocity. Unaffected by the pressure, viscosity, density, or changes in conductivity of the flowing liquid, it is recommended for aqueous solutions, slurries, acids, and other corrosives.

For further details, use Reader Service Card.

E—1228. Chemical Action Subs For Elbow Grease in Cleaning Shower Rooms—A quick means of removing unsightly discolorations and keeping shower stalls clean with little effort is afforded in a chemical compound being made available by Berman Chemical Co., who makes a number of claims for the product:

Known as Saf-T-Klenz, a powder-form cleaner has been developed especially for these purposes. In use, Saf-T-Klenz is simply sprinkled sparingly on a damp surface. After a few minutes allowed for dissolving, it is mopped lightly and then flushed with clear water. Algae accumulation, lime deposits, iron rust stains, soap oil and body grease, which have defied other cleaners, are removed without hard rubbing or scrubbing. Cleaning is by chemical action, rather than by "elbow grease."

Porcelain drinking fountains, wash bowls, toilets and urinals are similarly cleaned without effort.

It is also excellent for cleaning brass,

THE ANSWER TO YOUR TANK HEATING PROBLEMS

FOR ACID HEATING JOBS

G SERIES
FUSED QUARTZ
IMMERSION HEATERS

Over 40,000 CLEPCO Fused Quartz Heaters now in service.

Dependable, controlled heat at low operating cost.

Wide range of Standard Sizes for every need.

Only Fused Quartz Heater recommended and sold by all leading plating supply houses.

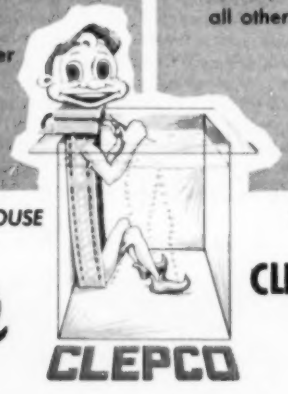
FOR ALKALINE HEATING JOBS

W & WS SERIES
STEEL AND STAINLESS
IMMERSION HEATERS

Specify CLEPCO Non-Magnetic Stainless Steel Heaters for your alkaline electro cleaners and bright copper plating tanks.

Specify CLEPCO Steel Heaters for all other alkaline tanks.

All leading Plating Supply Houses can furnish from stock.



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Clepco

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CLEVELAND PROCESS COMPANY
1965 EAST 57th STREET
CLEVELAND 3, OHIO

Bonus Filter Performance...

On Nickel Dip and Neutralizer Solutions at New Westinghouse Appliance Plant, Columbus, Ohio

A view of the two INDUSTRIAL filters—one on the nickel dip solution and one on the neutralizer solution. Each is a complete unit with primer-strainer tank, precoat slurry tank, filter, pumping unit, and all valves for filtration, addition of filter aids, free pumping, and filter drainage. Each filter is furnished with INDUSTRIAL air-wash manifold for cleaning filter.

Adequate turnover in the continuous filtration of the nickel dip and neutralizer solutions by the INDUSTRIAL filters assures dependable clarity. Furthermore, the air-wash cleaning feature eliminates the opening or dismantling of the filter for cleaning. The removal of the cover is necessary only for replacing the filter cloths or for periodic inspection—a great time and labor saver. It is this overall bonus performance that accounts for the universal use of INDUSTRIAL filters with the vitreous enameling processes.

Full Particulars and Recommendations for Any Job on Request

INDUSTRIAL FILTER & PUMP MFG. CO.

5914 OGDEN AVE., CHICAGO 50, ILLINOIS

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ION EXCHANGERS
RUBBER LININGS
HEAT EXCHANGERS
CORROSION TEST CABINETS
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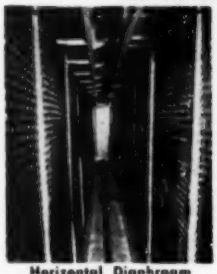
● A remarkable advancement in electroplating, Diaphragm Systems, engineered and installed by ARco have created a new high standard in plating production and quality.

Simply, economically installed, Diaphragm Systems efficiently segregate the anolyte from the catholyte through canvas barriers between anode and cathode compartments.

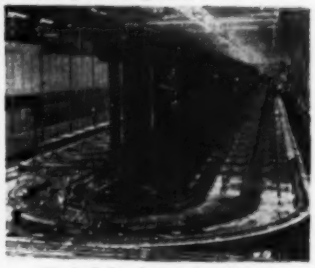
This ARco electroplating method, combined with ARco Rubber Lined Tanks and planned solution circulation, filters metallic insolubles from outside sources.

To reduce costly buffing due to roughness . . . prevent rejects resulting from thin spots . . . have an ARco engineer show you how simply Diaphragm Systems can save time, materials . . . and customers . . . for you.

Two Work Lane Diaphragm Plating Tank



Horizontal Diaphragm Installation



Vertical Diaphragm Installation

For uniformly high quality and economy in plating . . .

DIAPHRAGM SYSTEMS *and* RUBBER LINED TANKS *by* ARco

● ARco fabricated and insulated Diaphragm Plating Tank, return bend type.

GET THIS VITAL PLATING INFORMATION...SEND COUPON TODAY!
"Diaphragm Tanks Promote Plating Progress." This explanatory, illustrated booklet is yours without obligation. Send for it today!
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AUTOMOTIVE RUBBER COMPANY, INC.
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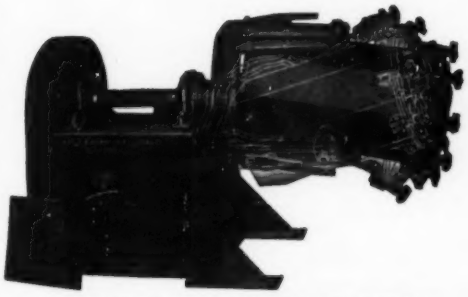
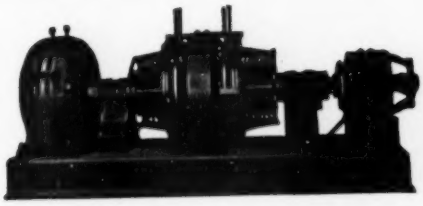
ECONOMY : EFFICIENCY : DEPENDABILITY

LET US SUPPLY YOUR NEEDS FOR YOUR PLATING OR POLISHING DEPARTMENT

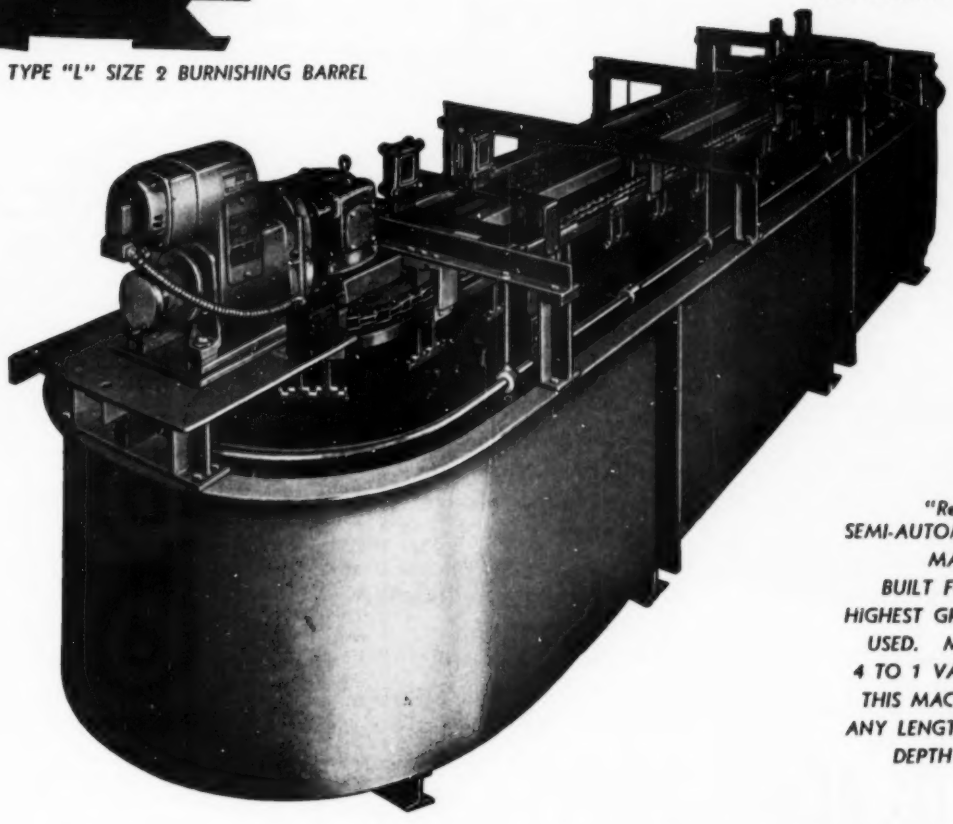
WRITE FOR FURTHER DETAILS



TYPE "L" SIZE 2 BURNISHING BARREL



3000 AMP. 6 VOLT GENERATOR SET



"Reliance" SEMI-AUTOMATIC PLATING MACHINE BUILT FOR SERVICE HIGHEST GRADE MATERIAL USED. MOTOR ½ HP 4 TO 1 VARIABLE SPEED. THIS MACHINE IS BUILT ANY LENGTH, WIDTH AND DEPTH OF TANK.

Chas. F. L'Hommedieu & Sons Co.

MANUFACTURERS of

Plating and Polishing Machinery

Complete Plating Plants Furnished

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FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 1643.

Equipment and Supplies

bronze or copper. Saf-T-Klenz is safe to use on glass, porcelain, china, marble, tile, terrazo, vitreous, and concrete surfaces. It contains no caustic, lye, soap or carbonate, and will not injure hands, clothing, floors or drain. Saf-T-Klenz is odorless—not perfumed—and does not mask odors, rather removes the cause.

It is claimed to be economical, requiring only one-fifth the amount of ordinary cleaners, and is sold with a guarantee of satisfaction or cancellation of invoice. It is not even necessary to return the unused portion.

By using the Reader Service Card, a liberal free sample, descriptive literature and prices are obtainable.

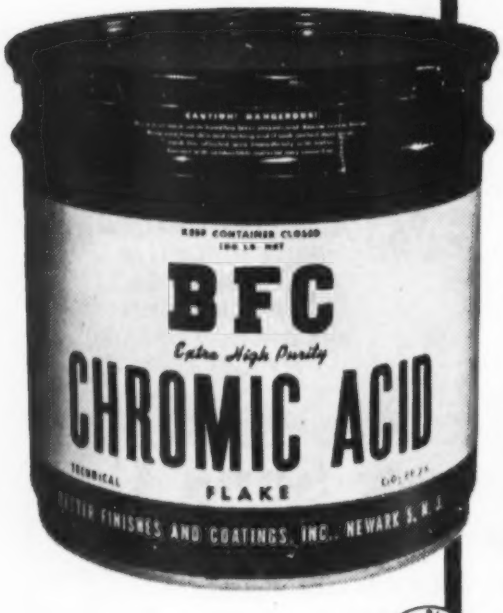
E—1229. Eltex Corp. Offers New Jetal Folder—Advantages of the Jetal Process for protecting and decorating irons and steels with a black oxide finish are fully detailed in a new folder offered by Eltex Chemical Corp.

The Jetal Process, according to the new Eltex folder, increases the wear resistance and toughness of ferrous metals. The finish becomes part of the metal as a deep black coating of high protective value, without affecting dimensions or surface texture.

Installation of equipment for the Jetal Process is simple, according to Eltex, and can readily be adapted to specific needs.

Eltex offers to demonstrate the process by Jetalizing samples of any ferrous product without obligation. The descriptive folder entitled "The Jetal Process" is available by using Reader Service Card.

looks good-
is good



First thing you notice about BFC Chromic Acid is its shiny cherry-red color as it comes off the flaker. It looks good and it is good. Its chemical analysis is as fine as its physical appearance.

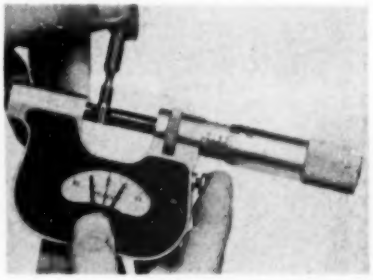
Our plant is modern; beautifully equipped; operated by men who are real proud of the product they make. Your orders will get personal attention of owner-managers who value your business. When you are in the market, why not call us?

BETTER FINISHES & COATINGS, INC.

268 Doremus Avenue,
Newark 5, N. J.

122 East 7th St.,
Los Angeles 14, Calif.

E—1230. George Scherr Co. Announces New Indicating Micrometer—An indicating micrometer providing "visible feel" to the user and having a range from 0–1 inch, reading in 0.0001 inch is announced by the George Scherr Company, Inc.



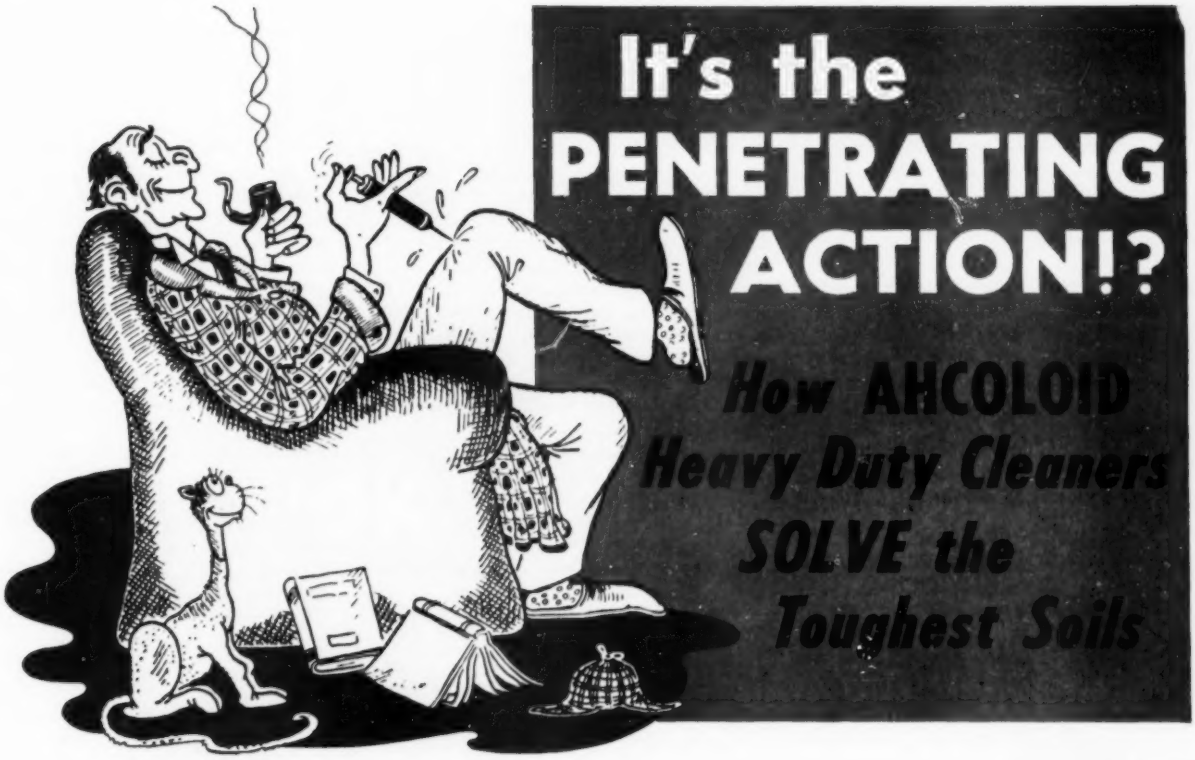
"Tenths" are easily and unmistakingly read from an extra large dial. The indicating mechanism controls the measuring pressure so that all uncertainties due to differences in "feel" of individuals are eliminated. The "Master Compar" indicating micrometer really offers what its name implies, namely a Master-Micrometer and a Comparator combined in one instrument. In addition, this tool provides the user, due to its ingenious design, with a complete set of Go and No Go Gages of one inch range, reading in 0.0001 inch. A most important feature is that it detects out-of-roundness, ovalness and taper. The fact that the release button for the movable anvil is on the right hand side makes it a right hand tool, enabling the operator to hold it the conventional way.

Radically new is the resetting to zero which is accomplished by means of a screw on the bottom of the housing and can be done accurately in less than five seconds. Heavy tungsten carbide anvils and finished hardwood case are standard equipment. Larger sizes up to 4 inches are furnished with removable indicator. Illustrated circular may be obtained by using Reader Service Card.

E—1231. Hammond Announces New Exhaust—Hammond of Kalamazoo announces an addition to their Duskolector line with their new Cyclone "8." This unit is available for exhaust to the outdoors and is designated the Model CYO-8. It can also be exhausted into three self-contained dust collecting bags and is then designated the Model CYB-8.

Here is a Duskolector with capacity to handle a large volume of dust and dirt from various types of dust-producing operations. The Cyclone "8" is well suited for many applications—buffing, polishing, general grinding, woodworking, plastics, glass, fibre, leather, and textiles.

This model will collect similar dust from multiple sources. As an example of its capacity, it can collect the dust



It's the PENETRATING ACTION!?

How AHCOLOID Heavy Duty Cleaners SOLVE the Toughest Soils

Sherlock Holmes knew a thing or two but he never dreamed of solving a case as fast as Ahcoloid Heavy Duty Cleaners solve cases of industrial soil! Drawing or stamping compounds, heavy oil or grease films, and industrial waxes come clean in no time when these fast-acting cleaners go to work. Whatever your cleaning problem, one of these cleaners is your best solution . . .

AHCOLOID CLEANER 202-A

This mild, low-pH soak cleaner is excellent for use on steel and most types of nonferrous metals, particularly to remove oily films with mineral oil base. Removes heavier oil films than most soak cleaners.

AHCOLOID CLEANER 202-B

Similar to 202-A but with higher alkalinity. Good to remove semi-solid, greasy, or waxy soils on steel and ferrous metals.

AHCOLOID CLEANER 213-B

This unique, low-pH soak cleaner is very mild . . . ideal on steel and stainless to remove drawing or stamping compounds and die lubricants with high metallic soap content . . . also drawing lubricants on phosphated surfaces.

AHCOLOID CLEANER 215

Economical soak cleaner for steel and nonferrous metals. Its low-foaming characteristic makes it ideal in tumbling equipment or for still tank processing. Many types of soil respond best to this cleaner.

Often cleaning problems arise from the unknown nature of the materials which cause the soil . . . why not submit your problem to our laboratory for testing and recommendations . . . without obligation.

CHECK AND MAIL TODAY

For more information about any of the above cleaners, check the appropriate box or boxes, clip, and mail to Apothecaries Hall Company, 22 Benedict Street, Waterbury, Connecticut.

202-A ☐ 213-B ☐

202-B ☐ 215 ☐

Apothecaries Hall Co.

Equipment and Supplies

from both sides of two average polishing and buffing lathes— and is so compact it can frequently be "tucked in" around the machines it serves.

For further information, use Reader Service Card.

E—1232. New Line of Fuse Cutouts Announced by General Electric—A completely new line of enclosed fuse cutouts with all operating functions available in one basic design has been announced by the General Electric Company's Distribution Department, Pittsfield, Mass.

Flexibility is accomplished with one housing and four interchangeable doors in each voltage and current rating. A choice of doors provide for normal duty indicating or dropout, normal duty indicating nondropout, indicating heavy duty or extra heavy duty, and disconnect functions.

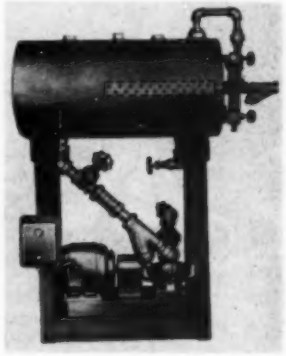
In addition to flexibility of operation, the new line will have other new and advanced design features, including: broad-faced, high-pressure V-wedge contacts that are free-floating, self-aligning, and self-wiping to assure low contact resistance and better alignment; compression clamping of the mounting support to the porcelain housing for maximum mechanical strength; new door handles that allow easier handling with conventional switchsticks; plastic-to-metal latching that reduces door binding; double-clamp line terminals with full length retracting shoe for quicker, easier and more effective line connections.

The new cutouts, which help provide distribution system and apparatus protection against short circuits and overloads, are currently available in voltage ratings of 5.2 kv and 7.8 kv, in continuous current ratings of 50 amperes and in all applicable NEMA Standard interrupting current ratings.

The 100 ampere cutouts in 5.2 kv and 7.8 kv ratings, with the same features as the 50 ampere line, will be available early in 1955, according to the marketing manager.

For further information use Reader Service Card.

E—1233 Cyclotherm Incorporates Preheater in Boiler Feed Systems—A new boiler feed system, incorporating a preheater that operates on steam from the



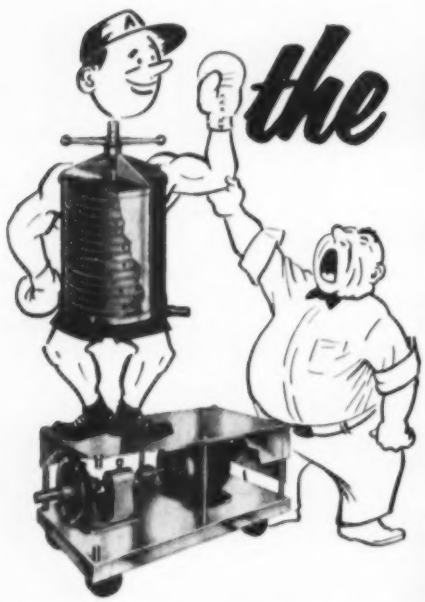
boiler, has been added to the Cyclotherm line of boiler feed systems for use in conjunction with Cyclotherm and other steam boilers. The new units, manufactured by Cyclotherm Division, United States Radiator Corporation, automatically maintain boiler feed water between 190° and 200° F. Tank sizes on the units range from 30 to 540 gallons. They will supply from 280 to 2800 gallons of preheated water every hour.

Cyclotherm engineers point out that preheating boiler water makes it possible to lengthen boiler life by eliminating stresses caused by low temperature feed water entering the already heated boiler shell. Preheating makeup water also make it easier for the boiler to maintain pressure during peak load periods and reduces boiler scale.

For additional details, use Reader Service Card.

E—1234. New Surface Treatment for Aluminum—Proseal No. 16, a new chromate conversion protective coating for aluminum and aluminum alloys, has been announced by Promat Division, Poor and Company.

Said effectively to inhibit corrosive action between paint and aluminum, the new protective film meets requirements specified in Mil-C-5541 for military aircraft applications; and, according to the manufacturer, is designed for use on any application where extruded, forged, wrought,



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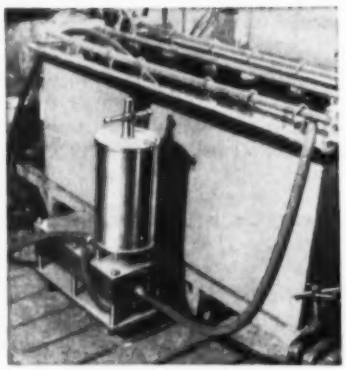

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or cast aluminum and its alloys are used.

Results of professional laboratory tests indicate that no changes in physical properties have been noted on panels treated with Proseal No. 16 after 500 hours of exposure to 20 per cent salt spray solution at 95° F.

Reported effectiveness of the film is attributed to the deposit of a high percentage of insoluble trivalent chrome, as opposed to a lower concentration of soluble hexavalent chrome. Relative ratio of the chromate films is maintained at about 5 to 1.

Outstanding advantages of the new chromate film, as reported by Promat, are: greater control over uniformity of film; low material cost; suitability for production coating of any aluminum component; and high protection from corrosion, when used alone, or as a base for paint.

For further information, use Reader Service Card.

E—1235. New Coating Announced—A new and powerful weapon against damage is End-O-Rust, a new zinc rich, resin vehicle coating now available from Industrial Craftsmen, Inc. Applied by brush, End-O-Rust bonds to any iron or steel surface, even a rusty one that is dry, free of grease and loose scale, and not painted with a tar or bituminous paint. End-O-Rust gives galvanized protection wherever a paint brush can reach, even on rusted surfaces.

For further information, use Reader Service Card.

E—1236. "Tuff-Tite" Is A New Fastener With Neoprene Washer—Townsend Company announced the development of a new multipurpose fastener with a one-piece metal washer head and assembled neoprene washer for use in preventing leaks, for protecting surfaces, absorbing shock and stopping squeaks.

When the Tuff-Tite fastener is seated, an undercut in the washer head traps and controls the flow of the neoprene at the outside edge, forming a perfect watertight and air-tight seal.

Tuff-Tite is a versatile fastener. It finds applications in the construction, transportation, electrical and chemical fields.

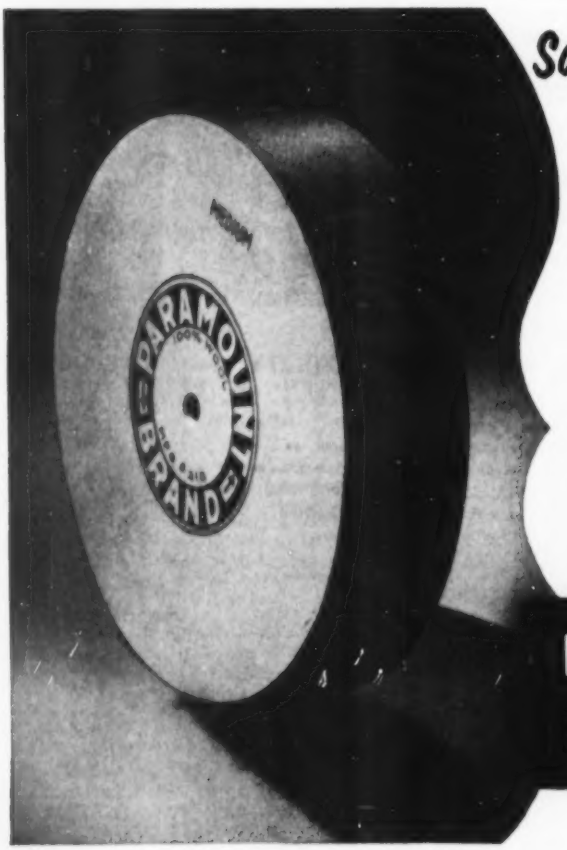
Neoprene washers can be preassembled and applied to self-tapping screws, thread-cutting screws, drive screws, stove bolts, machine screws, wood screws, nails and special products. The fasteners are available in stainless, carbon and alloy steel as well as many nonferrous materials, such as aluminum and copper. Screw diameters smaller than No. 6 (0.140 inch) are not recommended as Tuff-Tite fasteners.

Flat, concave or convex surfaces are no obstacle for Tuff-Tite fasteners because the neoprene washers will flow in any direction to conform with the contours of the surface. The patented conical design of the neoprene washer helps lock the neoprene to the threads of the fastener and actually forces neoprene into the hole and around the threads, insuring a water-tight and air-tight seal.

Neoprene, a synthetic rubber, resists abrasion, sunlight, aging, ozone and heat. It performs effectively in temperatures ranging from minus 65 degrees to 250 degrees Fahrenheit.

The neoprene washer retards electrolysis between dissimilar metals by insulating against direct contact. It is made to order for industries where electrolysis, heat or electrical contact pose a problem. Its excellent dielectrical properties permit its use as insulation material in the radio, television and electronic fields.

For additional literature, use Reader Service Card.



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CORROSION PROTECTION OF MODERN AIRCRAFT*

W. F. CASTELL†

ABSTRACT

The proper corrosion protection of all parts used in the construction of modern aircraft is of great importance. This discussion, however, is limited to the protection of aluminum alloys only since these materials still make up the major components of the airframe. The increase of the size and of the speed of the airplanes made the use of strong aluminum alloys such as 75S-T, mandatory. Today the use of large wing panels, as long as 50 feet and made of 75S-T aluminum alloy, have proven very satisfactory for the construction of a strong and light wing.

Corrosion problems during the machining and storage of 75S-T bare aluminum alloy parts were quite frequent and complex. The traditional chromic acid anodizing process was found to be uneconomical and unsatisfactory for the protection of such large parts. Chemical film treatments were investigated, and the Iridite No. 14 process was found to be most economical, best suited for maximum corrosion protection and also provided good paint adhesion. Large processing tanks were installed to apply the Iridite No. 14 process.

Fig. 2. Cross section of the above 75S-T clad skin. Notice the reduction of the protective cladding by corrosion. 165X

INTRODUCTION

A bright, shiny airplane is a familiar sight, as most

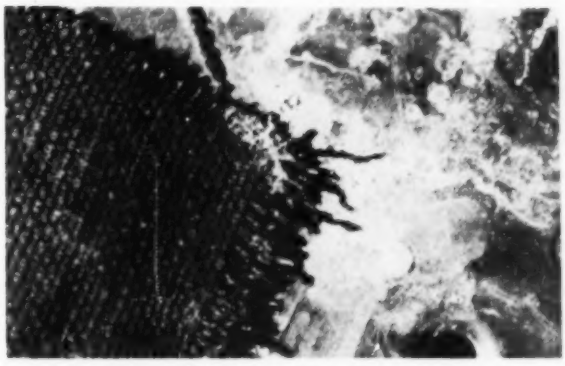

Fig. 1. Damage from fire proofed tarpaulin on a 75S-T clad aluminum alloy skin after prolonged outdoor storage. 2.5X

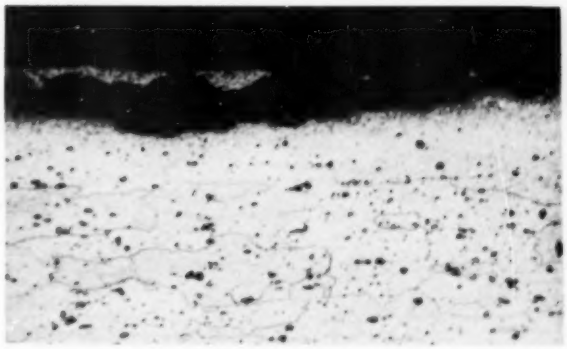

Fig. 3. Another cross section from Fig. 1. 165X

*Presented at the Forty-First Annual Convention of the American Electroplaters' Society, 13 June 1954.

†Process Control Engineer, Lockheed Aircraft Corporation, Burbank, California.

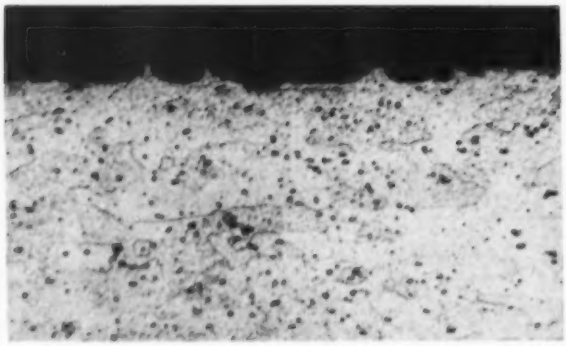

Fig. 4. Attack from HCl formed on radome during outdoor storage in bright sunshine. 165X Approx. 90 per cent of cladding is lost by corrosion. Original thickness of the cladding: 5 per cent of the 0.040 75S-T sheet or 0.002 inch

of the exterior surfaces of the plane are made of clad 24S-T or 75S-T aluminum alloy. The cladding, which is a layer of pure aluminum, possesses excellent properties to resist corrosion under normal weather and storage conditions. However, it is mandatory to keep the clad surfaces clean and to eliminate the accumulation of dust and dirt by regular washing and polishing. Naturally, if corrosive chemicals which contain either chlorides or sulfates, are allowed to stay on the surface of the cladding for any length of time, the pure aluminum will be attacked.

Figure 1 shows what happened when a careless mechanic left a fireproofed tarpaulin on the shiny surfaces of the plane. Moisture leached out the fireproofing chemicals which reacted very unfavorably on the aluminum. Figures 2 and 3 show a cross section of the damaged cladding, which can be repaired only by replacement of the corroded sheet or by the application of an organic finish. Figure 4 is a cross section of a 75S-T clad aluminum skin which was located close to a radar dome. Under the bright California

Fig. 5. Large machined wing panel. Material: 75S-T

sunshine the rain erosion coating on the radome broke down and hydrochloric acid was formed, which was washed down on the aluminum by the morning dew.

The design of large integrally stiffened skins for the construction of the lower-wing section of the Model 1049 Constellation specified the use of 75S-T aluminum alloy. This strong aluminum alloy, which contains up to 6 per cent zinc, can be heat-treated up to 80,000 psi; however, it is at the same time very susceptible to corrosion if not properly handled and protected during all transportation and machining operations. Figures 5, 6, and 7 show some of the largest panels which are machined from a thick plate. During the milling operation this thick plate is held in place by vacuum on the machine bed. Figure 8 gives

Fig. 6. Large machined skin approx. 50 feet long

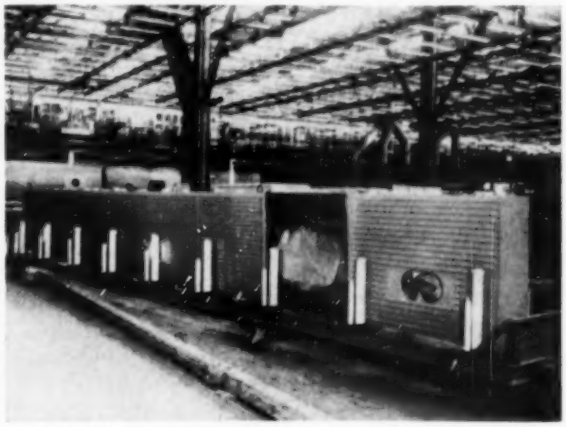

Fig. 7. Integrally stiffened skin for Constellation wing approx. 34 feet long and 4 feet wide

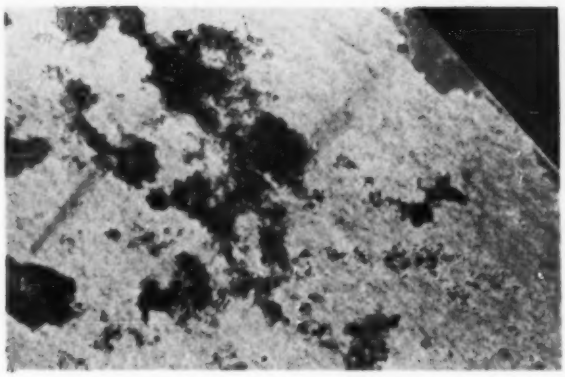

Fig. 8. Corrosion on 75S-T after being in contact with milling machine bed made of steel for several days. 43X

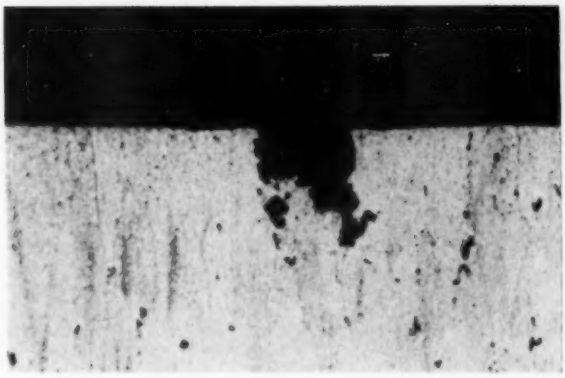

Fig. 9. Pit type corrosion. Cross section taken from 75S-T skin in Fig. 8

an indication of how much corrosion can take place if the vacuum plate is made of steel. The water soluble oil coolant is an electrolyte, and the vacuum plate is a large cathode having a potential of approximately 0.8 volts in contact with 75S-T aluminum alloy which presents a perfect set-up for electrolytic corrosion. The appearance of this corrosion is not very alarming as it seems to be just a black surface discoloration. However, when sectioned through this discoloration the extent of the corrosion is seen in Figs. 9 and 10. Figure 9 is a sample of pit type corrosion, while Fig. 10 indicates that the corrosion was allowed to progress for sufficient length of time to be intergranular. Experiments with cadmium or zinc plating the steel vacuum plates reduced the amount of corrosion; however, the real remedy to solve this problem was the use of aluminum vacuum plates.

Final Corrosion Protection

The available anodizing process did not prove the best protection for these large machined skins made of 75S-T bare aluminum alloy. The slightest amount of surface corrosion or pitting, which was started during the machining operations and was not entirely removed before the anodizing process, caused further corrosion because the oxide film was not continuous. The grey color of the oxide film made the inspection after anodizing difficult and resulted in passing small discolorations of harmless appearance which later proved to be the starting point of more serious corrosion (See Figs. 11 and 12). The repair of such skins after anodizing was difficult and expensive. Even a perfect anodizing finish did not always give the required protection during exposure to salt spray. The proper racking to provide electrical contact to these large parts required much time and caution.

Since the anodizing facilities available were not adequate for processing many large parts, new equipment was required. Initial evaluation of various chemical film processes, approved in the government specification MIL-C-5541, indicated not only a reduction in the equipment cost, but also satisfactory corrosion protection for bare aluminum alloys. After extensive tests in the laboratory of all the chemical film processes available at that time, the Iridite No. 14 process, produced by the Allied Research Products, Inc., was selected for its best over-all performance A simple immersion in the Iridite No 14 solution produced a thin chromium-chromate film (approximately 0.00001 inch thick) which showed far better corrosion protection to 75S-T bare aluminum alloy than the anodizing process. The tests did include not only all the requirements specified in MIL-C-5541, but also the service life of the solution was thoroughly tested by processing many samples of various shapes and alloys through a one gallon solution. The results of the stability and economical upkeep of the solution were remarkable. Small additions of nitric acid and Iridite No. 14 compound kept this one gallon solution satisfactorily operative through several weeks of operation until the equivalent surface of approximately 1,500,000 square feet of aluminum surface, as compared to the operation of a proposed 18,000 gallon tank, were processed. To keep the proper *p*H value constant presented no difficulty. Later, more tests were conducted in a 400 gallon production tank.

Fig. 10. Intergranular corrosion after long contact with steel in the presence of a synthetic coolant, which was a good electrolyte. 65X

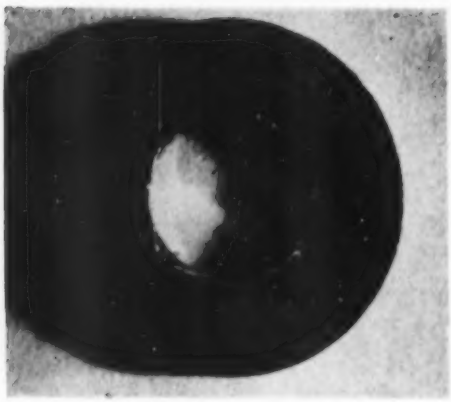

Fig. 11. Sample taken from 75S-T machined part which was anodized and stored for several months. 4X

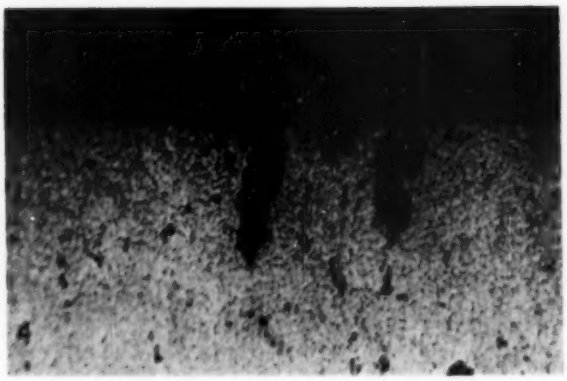

Fig. 12. Cross section of Fig. 11. 65X. The thin anodic coating is visible

The paint adhesion to the aluminum surfaces processed with Iridite No. 14 proved to be much better than the adhesion to anodized surfaces. The drying time of the primer also was greatly reduced, which might be partially due to the presence of the chromate ions in the Iridite film speeding up the oxidation process. New conversion coatings were successfully used over the Iridite coating while the adhesion to anodized aluminum was unsatisfactory.

A final protective finish for the surfaces of the large machined skins, which form part of the exterior contours of the wings, consists of the following steps:

1. Iridite No. 14 treatment.
2. Pretreatment (wash primer) Spec. Mil-C-8514 0.0003–0005 inch film thickness.
3. Zinc chromite primer—Spec. Mil-P-8585 0.0003-0005 inch film thickness.
4. Enamel Mil-E-7729 0.0015 inch Max. film thickness.

Processing Equipment for the Iridite No. 14 Process

On the strength of all this investigation, it was decided to use Iridite No. 14 in the large processing tank. Chromodizing facilities were included to process exterior skins made of clad aluminum requiring a bright finish. The new processing equipment was designed to the following specifications:

Unit Description	Materials of Construction
(1) Alkaline cleaner tank Steam heated (180–200° F) Circulating pump and overflow dam	Plain steel tank, steel pipes for 100 psi steam pressure
(2) Cold-water rinse tank Spray nozzles and overflow dam	Plain steel tank

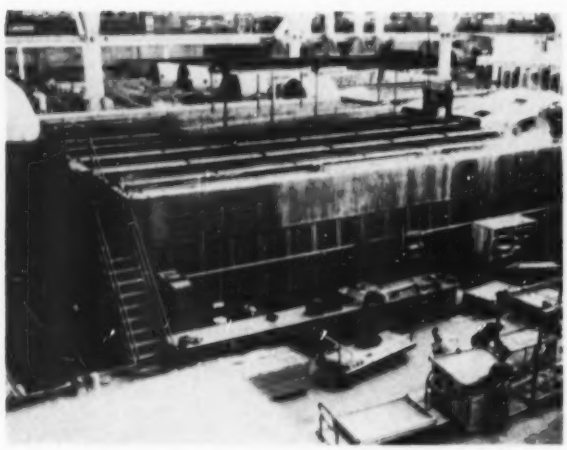

Fig. 13. Processing tanks. In front small parts are loaded in stainless steel trays and the trays in the large basket

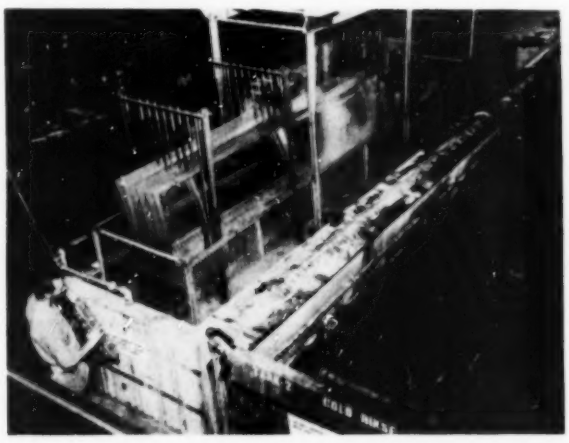

Fig. 14. Basket is lowered into alkaline cleaner tank. Notice koroseal covered stainless steel rods to prevent scratching of aluminum surfaces

(3) Chromodizing tank Steam heated Ventilated	Plain steel tank with steel steam coils
(4) Cold-water spray rinse tank	Thin gage steel tank with concrete bottom
(5) Deoxidizer tank	Koroseal-lined steel tank
(6) Iridite No. 14 tank	Koroseal-lined steel tank with stainless steel heating coil
(7) Cold-water spray rinse tank	Thin gage steel tank with concrete bottom
(8) Hot-water rinse tank	Vinyl-lined steel tank with vinyl-coated steel steam pipes
(9) Hot-air dryer Steam heated with 4 Airfin heaters and blowers	Steel tank with air-operated sliding lid made of steel frame and plywood

(All tanks of dimension: 50 ft long x 4 ft wide x 12 ft deep)

ADDITIONAL EQUIPMENT SPECIFIED

(10) Water demineralizer—to be connected to hot-water rinse tank to eliminate streaking or spotting of chromodized exterior skins from hard water deposit and at same time control *p*H below 6.8

(11) Recording temperature controllers—for chromodizing and Iridite solutions, and for the hot-air dryer

(12) Temperature indicators and self-actuating temperature controllers—for the alkaline solution and hot-water rinse tanks

(13) Exhaust ducts and fan—for the chromodizing tank

(14) Slurry tank—to facilitate chemical additions to the alkaline cleaner

(15) Portable stainless steel tank and pump—to make additions to deoxidizer and Iridite tanks

(16) Stainless steel baskets and trays (25 ft long)—to transport parts through solutions

(17) Stainless steel racks—to handle large machined parts

(18) Crane hoist—capacity of 8,000 lb

Fig. 15. Spray rinse and etch tank. Baskets must be thoroughly rinsed after the etching process before entering the Iridite No. 14 tank

Production Experiences

After the completion of the installation of new equipment, the total production of finishing all aluminum alloy parts was changed from the former anodizing and chromodizing tanks to the new Iridite and chromodizing tanks from one day to the next without major difficulties. This sudden change was so successful that within 48 hours the old equipment could be dismantled. Production has been running without interruptions since. In fact, it was immediately discovered that the Iridite No. 14 process was so much faster than anodizing, that manpower reductions were made right from the start.

A few adjustments in tank operations were found to be advantageous. Final operating conditions of each solution are as follows:

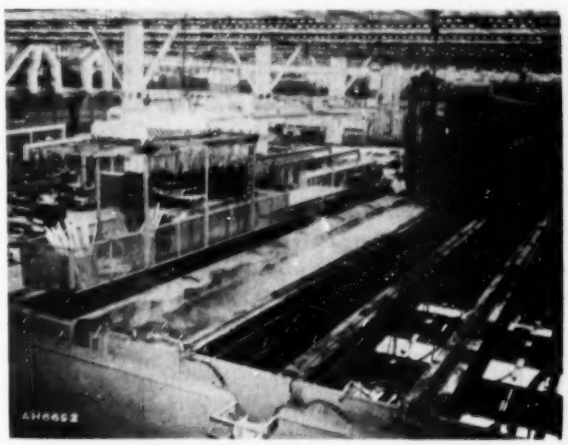

Fig. 16. Basket is entering the dryer. To the right is the etch tank and the next is the Iridite No. 14 tank. Notice pipes and nozzles of spray rinse tank

Alkaline cleaner solution	8 oz/gal aluminum cleaner* Operating temperature: 190° F Immersion time: 10 min minimum
Deoxidizing solution	8 oz/gal deoxidizing solution* with addition of 1 per cent of sulfuric acid Immersion time: 3 min maximum (without lowering *p*H, immersion time was critical, as smudge formed on bare 24S-T alloys)
Iridite No. 14 solution	3 oz/gal Iridite No. 14 compound Operating temperature: 85° F Immersion time: 3–4 min After more than one year of continuous operation, it has been determined that a daily check of *p*H proves advantageous in maintaining the solution within the range, *p*H 1.4–1.7, by frequent small additions of nitric acid.
Hot-water rinse	Operating temperature: 140–160° F Immersion time: 1 min maximum
Hot-air dryer	Operating temperature: 200° F maximum

A daily check of the *p*H of the solution proved to be advantageous in order to maintain the *p*H between 1.4 and 1.7 by frequent small additions of nitric acid. A constant operating temperature of 85° F and a concentration of 3 oz/gal of Iridite No. 14 compound seemed to give optimum results.

The temperature of the hot-water rinse is best maintained between 140–160° F, and the parts immersed for only one minute maximum time in order not to bleach more than a minimum amount of chromates out of the Iridite film. The drying temperature is maintained at 200° F.

Racking of Parts

The proper racking of the parts was found to be of the utmost importance to obtain a satisfactory Iridite finish. To handle efficiently the great variety of the parts, which vary from long spars 50 ft long and little clips and washers, large stainless steel baskets 25 ft long are used. The perforation of the baskets can be used to make an unlimited amount of partitions. Small parts are placed in trays or smaller baskets which are loaded in the large baskets. Only large machined skins 30 ft to 50 ft long required special racks.

The upkeep of the stainless steels is negligible as it is not attacked by the processing solutions. The former replacement cost of anodizing racks amounted to approximately $15,000 per year, although many parts were lost in the anodizing tanks due to breakage of rack clips.

Summary

Chemical film treatments, such as the Iridite No. 14 process, have proven to be very satisfactory for the protection of all aluminum alloys.

The greatest advantage of the Iridite No. 14 process is naturally the manpower and material savings, which amounted to approximately $40,000 for the first year of operation. On large parts torque wrenches were required to make the proper electrical contacts without distorting or injuring the parts. For the Iridite process, such parts are simply laid in the basket with the proper supports to allow good draining and about 3 times as many parts can be processed as previously in the anodizing tanks. The processing time in the anodizing tanks was at least 45 minutes while the Iridite No. 14 process requires only 3 to 5 minutes immersion.

After the nine months' operating experience, the following characteristic of the process was noticed:

The Iridite film is definitely softer than the aluminum oxide surface formed during anodizing; however, serious trouble was not experienced in handling the Iridited parts in fabrication. A great help is the fact that a damaged Iridite film is easily repaired by the local application of Brush Iridite solution. Scratched or damaged anodized parts always required rework in the tank.

Today the Iridite No. 14 process is used on all aluminum alloy parts which require corrosion protection and painting except for the protection of aluminum rivets. The protection of aluminum tubing is a good example of Iridite application because the finish can be applied after all bending and flaring operations. The Iridite film is uniform on the inside and outside surfaces of the tubing. On anodized tubing, the flared end and the inside surface had to be left unprotected. Small dissimilar metal parts, as steel inserts, fasteners, and clips, can be processed with the aluminum parts without being damaged. The Iridite film conducts electricity which is a definite advantage over anodizing finish for radio and radar grounding requirements.

Acknowledgments

The author wishes to acknowledge the cooperation of M. T. Angelo, Manager of the Manufacturing Technical Service Department, Lockheed Aircraft Corporation, in permitting the publication of this paper. He also wants to express his appreciation to E. S. England and Neg Shirts for providing the pictures.

*Name of material and manufacturer on request.

DISCUSSION

MR WELLER: Are all abraded surfaces repaired by brush application of chromate solution? Does the chromate film have self-healing properties?

MR. ARNOLD: That is right. They use a brush-on solution. The fact is that this type of protection is essentially a gel film. You get protection even though the surface is scratched, probably by the process of moisture leaching hexavalent chrome from the film and distributing it on the bare areas.

MR. JOHN F. MAXIAN (General Laboratory Associates, Inc., Norwich, N. Y.): You stressed the use of Iridite No. 14 on 75 S aluminum. Did you find results on other alloys to be as successful?

MR ARNOLD: This paper was written largely around 75 S, because this alloy is most susceptible to corrosion and requires adequate protection I believe Lockheed uses 75 S aluminum alloy to a great extent because of its high strength. I would say you get comparable results on other alloys, like 24 ST.

MR. MAXIAN: You mentioned 52 S.

MR. ARNOLD: All 52 S tubing is treated with the Iridite No. 14 process because of its excellent protective value. Previously 52 S tubing did not require any protection. But a change in the hydraulic fluid made such protection mandatory.

MR. MAXIAN: Of course, 2 S is considerably different.

MR. ARNOLD: Aluminum alloy 2 S is almost pure aluminum and does not corrode very readily under normal conditions; however, the chromate conversion film further increases the corrosion resistance and improves paint adhesion.

MR. MAXIAN: Are you using it on 3S aluminum also?

MR. ARNOLD: I would say that Lockheed is using it on all their alloys. They discontinued their anodizing and removed most of their anodizing equipment. The only thing they are now anodizing is rivets and parts that are not painted and require a hard surface.

MR. VEIT: Perhaps I can help answer the preceding question. At Grumman Aircraft we are using a similar type of proprietary chemical conversion coating. This is being successfully used on all the alloys we employ. Federal Specification Mil. 5541 is completely satisfied.

MR. MAXIAN: Is 24 ST also treated?

MR. VEIT: Yes, it is. However, 24 ST has one of the poorest salt spray resistances. That is why it is specified for test panels under the Mil. 5541 specification. When the conversion coating solutions are properly operated, there is no reason why 24 ST should present any problem.

MR. MINOR HARRISON WHITE (General Motors, B.O.P. Division, Kansas City, Kans.): If there is no reaction between the zinc chromate primer and the anodized or chemical film, why should there be a difference of paint drying time on the two films?

MR. ARNOLD: I cannot give you a complete answer on that. I would assume that the gel type Iridite coating has an absorptive nature and that the chromate ions speed up the oxidation process.

MR. WHITE: I ask that because we are having drying trouble on anodizing films.

MR. ARNOLD: From indications in this paper, Lockheed had the same thing. Mr. Castell states definitely that Lockheed decreased their drying time, which is a saving.

MR. WHITE: Is the assumption correct that this film is clear and does not discolor exterior Alclad surfaces and that it is being used on Alclad surfaces?

MR. ARNOLD: Only short immersions, less than 30 seconds, will produce a clear coating. Normally it does leave a yellowish film and that is why they had to keep their chromadizing tanks. I believe the commercial airlines want bright or clear finishes on exterior surfaces. Normally, with this type of coating the deeper the color, the more corrosion resistant is the film. Generally speaking, this is true.

* * *

The life of a fluorescent lamp now can be predicted almost instantly—something which formerly could be determined only by burning one of them until it blinked out after an average 7,500 hours. Other things being equal, fluorescent lamp life is proportional to amount of emission coating held by the lamp's cathode, according to Richard N. Thayer, General Electric engineer. The amount of emission material, which serves as source of electrons to carry current through the lamp, is estimated electronically without breaking open the tube.

* * *

First Nuclear Reactor for industrial research will be established at Armour Research Foundation after AEC approves design and schedule of operation. Reactor, or "atomic pile," will be housed in a new 8,000-square foot building on Illinois Tech's campus in Chicago. It is planned that it will be ready in 12 to 16 months. The reactor, a highly flexible neutron and gamma source for exploiting these radiations in research and development programs, is designed for ultimate operation of 50,000 watts or higher. Industry is interested in this new tool because it will permit inquiries into sterilization of foods and drugs; structure of plastics, rubber, glass, ceramics, and other materials; nature of wear and friction; development of metals and alloys, and medical techniques.

A LARGE-SCALE ELECTROLESS NICKEL CUSTOM PLATING SHOP*

G. GUTZEIT† AND R. W. LANDON‡

Electroless nickel plating is the name given to a chemical method for deposition of a high-nickel, low-phosphorus alloy upon a wide variety of base metals, including iron, most of the steel alloys, copper, brass, bronze, and many aluminum alloys. This chemical catalytic reduction process differs from electroplating in that no current and no electrodes are required for its application. Deposition takes place at a uniform rate wherever the bath touches the part, without the use of any electrical equipment. As a result, there is no substantial variation in plating thickness even for the most complicated shapes. The coating has high hardness, and its resistance to corrosive attack in many cases exceeds that of wrought or electrolytic nickel.

While a patent was issued in this country as early as 1916, the first practical system for electroless nickel deposition was that developed at the National Bureau of Standards by Dr. Abner Brenner and patented in 1947. General American Transportation Corporation has a large number of patents and patent applications on substantial improvements to the basic system for increasing plating rates,[1] providing a smooth lustrous surface and giving high stability to the plating solution.[2]

In order to discuss properly the commercial application of electroless nickel coatings, which have been gaining prominence in recent months because of their exceptional uniformity and negligible porosity, it is necessary to examine the general characteristics of the industrial plating solution.

The chemical equation frequently used to describe the electroless nickel reduction is not strictly correct, but it does suffice to show the general nature thereof:

$$2Na(H_2PO_2) + 2H_2O + NiCl_2 \xrightarrow{\text{Catalyst}} 2NaH(HPO_3) + Ni^\circ + 2HCl + H_2$$

From this equation we see that the combination of sodium hypophosphite and nickel chloride at a catalytic surface in a water solution produces:

(a) metallic nickel
(b) sodium phosphite
(c) hydrochloric acid
(d) gaseous hydrogen

Knowing the general form of reaction and its products, we can determine the requirements for handling:

1. It is desirable to operate the bath while plating at the highest feasible temperature since the rate of the chemical reaction increases sharply as the temperature rises. Electroless nickel baths are generally used at 185° F to 210° F. The Kanigen process operates at the higher temperature to keep the plating rate high, i.e., about 0.001 inch per hour.
2. Any particle of very small radius can act as an active point for localized decomposition of a catalysable chemical solution such as the electroless nickel plating baths. When nickel deposits on one of these particles, it acts in turn as a catalyst, and the plating reaction proceeds. In time a large portion of the available nickel in solution can be used up in this wasteful manner. Accordingly, the bath should be filtered continuously to take out any dust, free nickel, or other small foreign particles that might act as nuclei for bath decomposition. In order to obtain thorough removal of microscopic suspensoids, the use of filter aid is indicated. This in turn presents a difficulty, because the millions of small particles in the filter aid can cause decomposition of the bath. The problem can be solved by cooling the bath prior to filtration,[3] and by adding special reagents to promote stability.
3. The concentration of chemicals in the bath is obviously reduced as plating progresses. If this is allowed to continue, the reaction will ultimately stop. At the same time the plating which results from a bath the concentration of which is gradually decreasing, will result in a series of laminations. This can be prevented by continuous replenishment of depleted chemicals. The plating produced thereby has no discernible crystal structure when observed by optical microscope, electron microscope, or X-ray diffraction apparatus and has been proven nonporous in coatings 0.0002 inch thick or thicker, by the standard aerated hot water test and by special methods (gaseous diffusion and blocking of soft radiations).

It is not possible to add the regeneration solutions to the hot bath because local decomposition will take place in the zone of high concen-

*Presented at the Forty-First Annual Convention of the American Electroplaters' Society, July 15, 1954.
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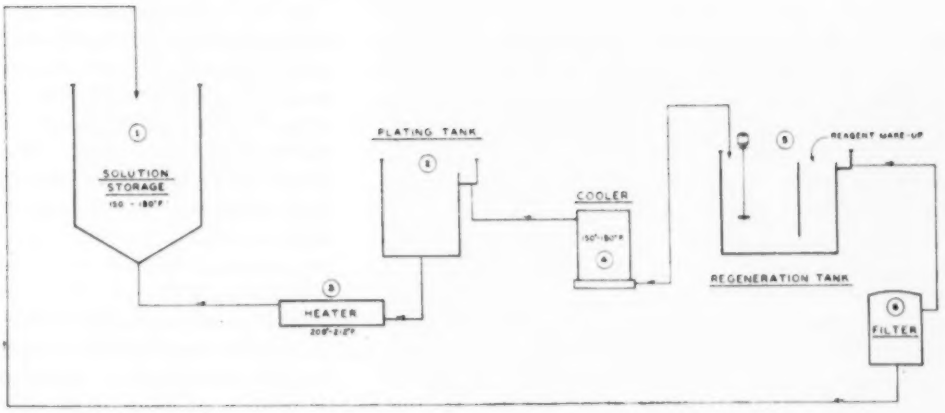

Fig. 1. Schematic flow sheet of "GATC" plating plant

tration around the point where the additions are made. If the bath is first cooled to a relatively low temperature, the regeneration chemicals can be added with impunity.

4. One of the products of the plating reaction is acid which depresses the solution *p*H. Any significant decrease in *p*H will lower the plating efficiency, slow down the rate of deposition, and reduce the brilliance of the deposit. Fortunately it is simple enough to correct the *p*H by slowly adding an alkali to the bath. While the addition can be controlled manually, it is very convenient to do this automatically with a *p*H meter, which operates a reagent feeder pump connected to the caustic supply.

Figure 1 schematically shows the necessary equipment for this process. The bath is originally compounded in the make-up tank where the nickel salt, hypophosphite, water, and additives are mixed together. It is then transferred into the continuous flow system.

The bath is pumped through a heater where it is elevated to the plating temperature. After flowing through the plating tank, the depleted bath is cooled and pumped to the regeneration tank where the concentration and *p*H are brought back to the original levels. Additions are made directly and continuously into the regeneration tank in the proper amounts. After regeneration, the bath goes through the filter and once again to the heater.[3]

Figure 2 is merely an elaboration of the one just discussed. It is a schematic representation of the system used at the General American Transportation Company's plants in East Chicago, Indiana, and Los Angeles, California.

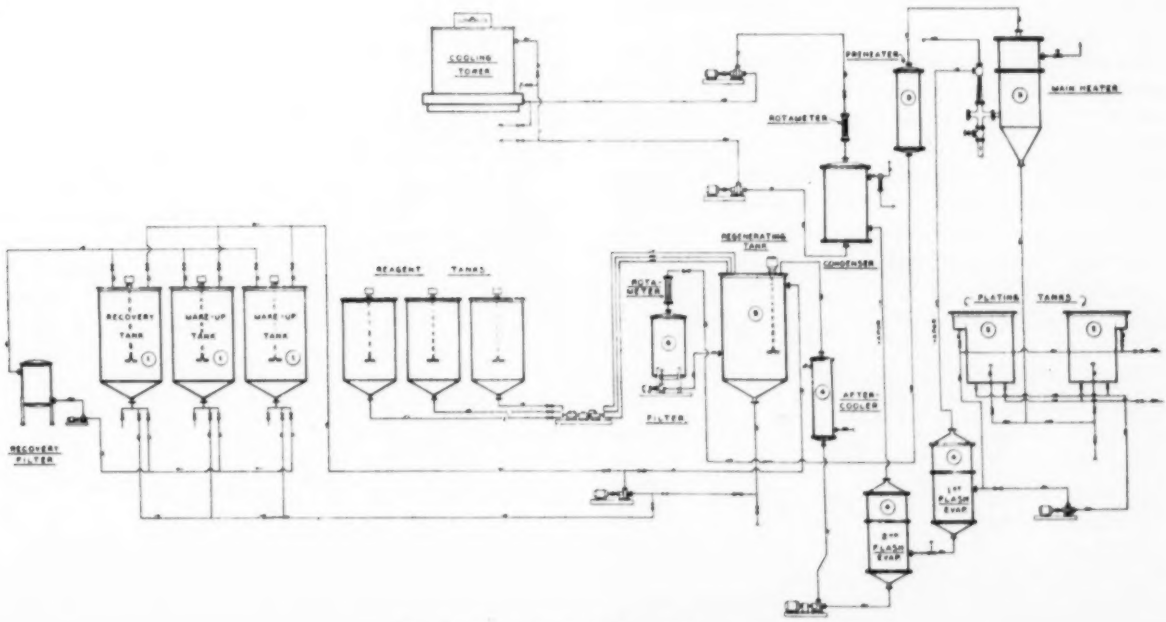

Fig. 2. Flow sheet of East Chicago plant

The new bath is made up to optimum concentration, including all additives, in the make-up tanks. After compounding, the bath is transferred to the plating circuit, where it is pumped through a leaf-type filter, through a tube and shell heat exchanger, and on through the primary heater where the temperature is raised to about 210° F. The bath is heated partially by direct steam injection and partially by heat recovered from the first cooler. By transferring part of the heat of the depleted bath to the regenerated bath, a considerable saving in steam can be effected. Patent applications have been filed on this system, and most of the claims have recently been allowed.

A comparatively high rate of flow is maintained through the system in order to keep the depletion of the bath to an acceptably low value and to maintain highest plating quality. A secondary advantage of a sizable flow rate is that it produces a fair movement of solution past the part and permits plating many pieces without mechanical agitation.

Once the bath overflows the plating tank, it proceeds by gravity through two flash bodies where the temperature is reduced by evaporative cooling to the regeneration temperature of about 140° F. Vapors from the first flash body go to the injection heater, where they are used to help heat the incoming bath. Vapors from the second flash body (which are only water) are discarded. The system is balanced so that the weight of vapor discarded from the second flash body equals the weight of steam injected in the primary heater. Accordingly, the solution is neither diluted nor concentrated by this direct heating-cooling system.

In the regeneration tank, nickel salt solution, sodium hypophosphite solution, and caustic solution are added continuously by reagent feeder pumps connected to the three reagent tanks. The pumps are controlled so that the additions correspond to the amounts used in plating.

Reagents are dispersed through the solution in the regeneration tank by a Turbomixer as the bath continuously flows through the tank. Once up to plating temperature, the flow of the bath is not stopped until the day's plating operation is complete. After the bath leaves the regeneration tank, it goes to the filter and once again through the entire circuit.

The bath can be used until such time as the concentration of phosphite ions builds up to the point where nickel phosphite, a relatively insoluble compound, begins to precipitate out of solution. Once a nickel phosphite precipitate begins to form, the bath should be discarded or reclaimed.

Since the organic additives in the electroless nickel plating solution are not consumed, it is desirable to reclaim a spent bath by removing the phosphite ions. A procedure has been developed for such reclamation, which reduces the applied cost of the plating. In some smaller installations it may be more desirable to discard the bath, which is 90 per cent water, rather than to attempt reclamation.

In the equipment design, it will be noted that the area exposed to hot plating solution is purposely very small. It is desirable to use glass pipe when the temperature is above 165° F to prevent plating on the pipe. Below this temperature, plastic coated steel pipe can be used satisfactorily. By locating the pumps in the cooled portion of the circuit, cast iron or stainless steel pumps can be used with no problems of plating in the pump. Due to the relatively low temperature, the regeneration tank is not subjected to plating to any degree. However, since some plating might take place over a very long period of time, the regeneration tank has been coated with a baked phenolic resin which is quite satisfactory. Heat exchangers and plating tanks are made of stainless steel, phenolic resin coated.

The ideal material of construction has not been found for the plating tank. The phenolic coatings are satisfactory for a time, but eventually deteriorate due to the elevated temperature of the bath. Glass is a good material, but will ultimately plate when used for a long period, especially if it is scratched. Glass coating on steel, except for the ever-present danger of cracking and scratching through the usual abuse received in a commercial shop, would appear to be the best material for plating tanks. So far it has been impossible to obtain glass coating on large sized, rectangular plating tanks.

Plating barrels made of melamine stand up very well and have given excellent use for a long period of time. So far we have had no failures of the melamine barrels. It is not necessary to have the electrodes normally associated with such barrels. One desirable feature when barrel plating is that the plating rate is the same in a barrel as on a rack. The same uniformity of deposition occurs in a barrel as out, with no possibility of burning.

In many cases, when a large vessel needs plating, it is only the interior surfaces that require coating. This is an ideal situation from the standpoint of electroless plating with the system shown here, for the part itself can be used to replace the plating tank. The solution is merely pumped into the vessel and out again with plating occurring wherever the bath touches the part.

In most respects, parts should be handled in an electroless nickel bath in the same manner as they are handled for electrolytic plating. For involved surfaces, especially where heavy coatings are being applied, it is desirable to agitate the part during plating. Either vertical or horizontal agitation appears to be satisfactory to eliminate clinging gas bubbles or to shake off any falling bits of foreign matter. As when electroplating, it is necessary to orient the part properly or to provide agitation or rotation so that gas will not be entrapped during plating. The gas evolution from an electroless nickel bath is somewhat in excess of that normally produced by electrolytic nickel plating, so care must be given to the problem of gas entrapment.

The pretreatment of parts for electroless nickel plating is essentially the same as for electrolytic plating. Both methods require a properly cleaned surface if

good adhesion and minimum porosity are to result.

Because we use no electrical equipment in plating, soak cleaning techniques have been proving quite satisfactory. They do have the disadvantage, though, of requiring more cleaning tanks than are normally needed for electrocleaning processes. We use a double cycle of an alkaline cleaner, rinse, acid pickle, and rinse. Where necessary, products go through the vapor degreaser as the first operation.

When electrocleaning is employed, the standard processes of cathodic and anodic cleaning in an alkaline solution followed by an acid dip yield satisfactorily cleaned surfaces on parts of regular configuration. Where there is much contour to the piece or interior surfaces are involved, it is necessary to use specially shaped cleaning anodes In some cases it is impossible to clean all surfaces electrolytically and soak cleaning must be employed.

The equipment required for cleaning is standard and will not be discussed here in detail. The usual tanks for alkaline cleaners are steel. A variety of materials are satisfactory for acids; we currently use acid brick for hydrochloric and sulfuric acids; the nitric-hydrofluoric acid mixture needed for the preparation of aluminum parts for plating is contained in carbate lined vessels.

In soak cleaning, most of the solutions are used above room temperature, so it is necessary to install heaters which may be of steel for alkaline cleaners and carbate or glass for the acids.

Racking problems for electroless nickel are extremely simple. Since there is no anode to worry about and no problems of shielding or throwing power, usually it is merely necessary to immerse the part in the bath. Especially where the nickel thickness is limited, the position of the part in the bath is relatively unimportant.

One feature of great importance with electroless nickel plating is the ability to shift from one category of work to another with a minimum of setup change. It is possible to plate a load of conveyors as seen in Figure 3 and have the next load be a group of miscellaneous small parts. Small pieces and large pieces can be plated simultaneously (Figure 4.) It is possible to plate on different basis metals at the same time, even to plate bimetallic assemblies. The bath is operated in the same manner for any of these conditions, though pretreatment cycles may be different for different basis materials.

The labor requirements for an electroless nickel setup are probably very close to the requirements for automatic electrolytic plating and much less than other forms of electrolytic plating. The plating rate of General American's solutions is about 0.001 inch thickness per hour which corresponds quite well with commercial electrolytic nickel plating. While the soak cleaning techniques require more time than electrocleaning, it is possible to maintain equivalent throughput of material, so no increase in labor is required.

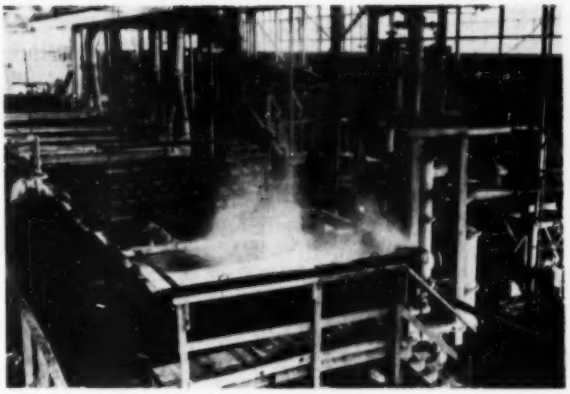

Fig 3. Conveyor parts

We operate the plant with three men on the plating line. One man controls the cleaning line, the second controls the plating, and the third acts as helper and racker. Of course, the jobs overlap as necessary.

The continuous flow plating system itself is sufficiently stable, so it is necessary to make only infrequent observations of the recording instruments. Actually, we find that the operators soon become so familiar with the bath that they can tell very quick y by color differences whether or not any significant change has taken place in the bath composition.

One of the major requirements for labor in electro plating, especially when plating interior surfaces of large pieces, is maintenance of specialized racks and anode assemblies. No anodes are required for chemical nickel deposition, and racks are usually very simple because no electrical connection is involved. This results in a sizable saving in labor and material.

Another factor for electroless nickel on the savings side of the ledger is the fact that thin coatings of electroless nickel give equal protection to electrolytic plating two to three times as thick in many places. Thinner coatings mean less labor cost in the finished article.

In addition to the three platers, an inspector is employed to keep close watch on quality. A laboratory technician makes routine analyses of new baths and of the production bath in the regeneration tank. Cur-

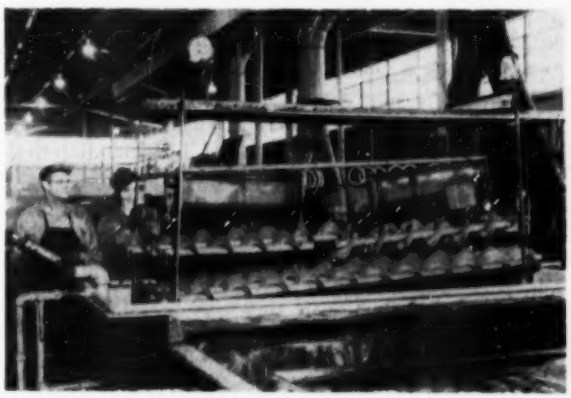

Fig. 4. Tank load

rently, we are running laboratory analyses about once an hour, primarily to build up a history of operation. It appears that this analysis schedule can be cut drastically, probably to once every four hours. This is especially true where a long run of a single product is going through. It appears that when the operators become more familiar with electroless nickel plating, they can dispense with some of the intermediate analyses. It is not wise to have the periods between analyses run too long because such analysis can readily forecast when a bath should be discarded or reclaimed and a new one brought in. If, as explained earlier, the bath is used too long, nickel phosphite begins to precipitate with subsequent roughness in plating.

Electroless nickel is a comparatively simple process; that is, if everything goes right. On the other hand, there are many pitfalls. Most of them have been experienced. We first used laboratory personnel for production. We found that the switch is not easily made. The laboratory technician is excellent on details of chemical phenomena, but does not readily comprehend the problems of production. We have about gotten over that hurdle now with current plating proceeding in good, routine fashion.

The development of maintenance schedules is especially important. It is necessary to keep the equipment clean and to eliminate deposits of nickel in the plating tank before it builds up to any appreciable area. Once this routine is established, it is very simple to clean up the tanks by brushing out any loose material and dissolving the rest with nitric acid. If this is done at definite intervals, the system functions very well and the time required for cleanup is insignificant.

Particular attention must be paid to the water used. It is important to have good water throughout the entire system, including precleaning tanks, if one is to obtain highest quality plating with best corrosion resistance. We started out with city water from Lake Michigan. Much to our dismay, the quality of plating varied with the seasons. It was better in the winter than in the summer. Various water contaminants were found to be at fault. As a result, we have put in a deep well and now have a good supply of constant analysis soft water.

Electroless nickel is a new material with most of the attributes of and some advantages over wrought or electrolytic nickel. The cost of materials is at this time substantially higher than for electrolytic nickel. The cost of application, on the other hand, is less than that for electrolytic nickel in many cases, especially for short runs of coatings 3/10 mil thick or thicker. Improvements that are contemplated are yielding coatings of relatively high brilliance that may give it application on some of those decorative parts which are comparatively difficult to plate electrolytically. Already it has shown the ability to give increased resistance to corrosion, including salt spray, especially when applied to parts of complex contour.

REFERENCES

[1]U. S. Patent 2,658,842, Gutzeit and Ramirez, Nov. 10, 1953 (Filed Jan. 4, 1951).

[2]U. S. Patent 2,658,841, Gutzeit and Krieg, Nov. 10, 1953 (Filed Nov. 8, 1950).

[3]U. S. Patent 2,658,839, Talmey and Crehan, Nov. 10, 1953 (Filed April 12, 1951).

DISCUSSION

MR. L. M. MORSE (Chrysler Corporation, Detroit, Mich.): I would like to ask you what determinations you believe are necessary to control the bath. The second question is: What is the duration of time from the time you take the sample until the determination is completed?

DR. GUTZEIT: We determine nickel, hypophosphite and phosphite in the bath. We have developed a method for hypophosphite control which is covered by patent and takes about ten minutes actual work, but involves a waiting period of 30 minutes. For phosphite the procedure is volumetric and takes about 20 minutes actual working time while a waiting period of two hours and 30 minutes is necessary. Nickel is determined colorimetrically using the classical bromine-dimethylglyoxime method, which takes about ten minutes.

MR. J. M. WELLER (Minneapolis-Honeywell, Minneapolis, Minn.): Is selective plating possible or feasible?

DR. GUTZEIT: What do you mean by selective plating?

MR. WELLER: Where certain areas are masked—

DR. GUTZEIT: Oh, yes, that is possible, although I want to say that we have had a very hard time finding a masking compound that would stand the high plating temperature of the bath. We finally found one that is manufactured by United Chromium Company, and later two other products that are satisfactory.

MR. WELLER: I think you mentioned minimum thickness requirements under ideal conditions for corrosion protection on steel?

DR. GUTZEIT: That statement should be qualified. Let me put it this way: Minimum thickness for corrosion protection depends a great deal on different factors. The first factor is the original roughness of the steel. It is well known that highly polished or smooth steel will give a coating that will afford much better protection than rough steel. Second, the required minimum thickness depends on the nature (type) of the steel. Third, the required thickness depends on the homogeneity of the original steel surface, for instance whether there is any embedded slag or other inclusions and segregations which cannot be removed during the precleaning cycle. It is hard to say such and such a thickness of "Kanigen" coating will be all right. Brass, for instance, is a highly homogenous material. We know that 0.2 will give very good protection on a polished brass base. On steels one might have to go up to 2 mils or even 3 mils, before one gets good protection.

MR. PHILIP H. EISENBERG (Sylvania Electric Products, Inc., Bayside, L. I., N. Y.): What is the per cent phosphorus in your nickel as deposited?

DR. GUTZEIT: About 7 per cent.

MR. EISENBERG: Does this result in a brittle plate?

DR. GUTZEIT: Yes, the nickel plate is much harder and consequently much more brittle than a ductile type electrodeposited nickel. Incidentally, as far as we know, it is a solid solution of phosphorus in nickel and not a nickel phosphide.

MR. EISENBERG: We at Sylvania have run X-ray diffraction tests and have found that it is present as nickel phosphide. What about the tank liners—what type of liner do you use?

DR. GUTZEIT: So far we have been using baked phenolic coatings such as heresite, lintite, and similar products—they are not perfect because they can be scratched easily and, when the secondary unwanted nickel deposit is removed mechanically, more damage may result. Moreover, when you treat these tanks with nitric acid several times to dissolve adherent nickel coatings you might get a little surface carbonization and, after a long time, the lining will break down eventually so that the tank will have to be relined. The ideal coating would probably be either glass or enamel, but we have not found anybody who will manufacture glass or enamel lined 14,000 gallon tanks. We are now trying various kinds of materials in our pilot plant and production plant and we believe we have found a solution, but it is too early to make a definite statement, and I might be able to tell you about it at the next AES annual meeting.

MR. EISENBERG: Actually, you would still have the same problem with glass once it was scratched.

DR. GUTZEIT: Yes, but that would not be as bad. We have been running in the laboratory in glass vessels for years and we never had any trouble. It is very easy to remove with nitric acid or mechanically a little deposit that adheres to a scratch.

MR. EISENBERG: One further question: How does the cost of this type of nickel plating compare to that of say, bright nickel that is being used commercially? What I mean is considering both the price of setting up the equipment and running the solution?

DR. GUTZEIT: That is one of those questions that is hard to answer because you can do with electroless nickel things that you can simply not do with electroplating. Take the interior of a valve, you just cannot coat it with electroplating techniques; or, if you try, it will cost you a fortune. Therefore, you cannot compare two procedures that are entirely different, particularly in such cases where one cannot do the job. Now, on simple parts, where both methods can be applied, the cost also depends on the pretreatment on the base material, etc. I would say that the selling cost of "Kanigen" varies in very simple cases at this time on steel from say $0.80 to $1.25 per square foot per mil. We hope to cheapen it in the future.

MR. EISENBERG: Would you like to comment on the article in *Metal Finishing* in January of this year (N. Hall, *Metal Finishing*, p. 52 (Jan., 1954.) They reviewed what is new in plating and in which they very emphatically said that Kannigan had done nothing but ballyhoo the Brenner electroless nickel.

DR. GUTZEIT: Well, let me tell this: The Brenner process in the acid bath gives a plating rate of about 0.2 mil/hour—up to a maximum of 0.5 mil/hour. We can get the rate up to about 2 mils. We get, we believe, a much higher bath stability and a homogeneous structure. We have tested the Brenner process for quite some time. While in laboratory plating experiments it was fine on small parts, in large production we could not use it and we have had to develop our own baths which are different, particularly in so far as additives go; we have had to develop our own system which I have just described, and which is different from Brenner's patented method. At least insofar as we are concerned, we did not have much luck in large production with the original Brenner patent.

MR. N. A. TOPE (Montgomery Plating Company, Ltd., Coventry, England): The author referred to the vital role of a pure water supply. In particular, what impurities proved detrimental? Were they of inorganic or organic origin?

DR. GUTZEIT: They were mostly of organic origin. Of course, if you have very hard water, with large amounts of calcium, for instance, the latter may precipitate calcium phosphite at high *p*H. But the impurities that were detrimental in our case to adhesion and salt spray resistance were mainly organic compounds, probably of the amine class—in other words, decomposition products of proteins.

MR. EDWIN R. BOWERMAN (Sylvania Electric Products, Inc., Flushing, N. Y.): We know that electroless nickel dissolves much more rapidly in nitric acid solutions than electrodeposited nickel. Just what are the corrosion properties of electroless nickel?

DR. GUTZEIT: We have not found that our "Kanigen" nickel plate dissolves any faster in dilute nitric acid solutions than electrodeposited nickel. In dilute sulfuric acid (1 to 10 per cent) our electroless nickel is considerably more resistant than electrodeposited nickel. In strong alkalies, such as 72 per cent caustic at 240° F "Kanigen" outlasts pure nickel from four to ten times. In cyanide its resistance is about four times better than that of electro nickel. If plated on a clean, smooth steel basis or on copper alloys salt spray resistance of "Kanigen" is better than 200 hours for 1 mil and sometimes will withstand over 1000 hours.

MR. J. O. HINSHAW (North American Aviation, Downey, Calif.): Dr. Gutzeit, if there are special procedures for cleaning and electroless nickel plating aluminum, will you describe these procedures?

DR. GUTZEIT: There are special procedures for cleaning aluminum before "Kanigen" plating that metal; while the plating procedure itself is generally identical to that used for any other base material. Because our patent applications on the above subject are still pending I am not at liberty to disclose any details.

A CORRELATION OF METALLURGICAL HARDNESS AND BUFFABILITY*

HAROLD FAINT†, AND R. SCOTT MODJESKA‡

When the buffer asks the plater to give him a softer deposit, what does he mean? None of us can recall a time when we haven't heard the arguing which goes on constantly between the buffing department and the plating department as to whether the plate is soft, or whether the plate is hard. The shiners are always beefing at the dippers, and the dippers are always griping at the shiners. That problem has an age equal to that of our field. It is a problem we felt should be studied since it is a basic problem in our industry.

Any evaluation which depends upon a personal factor, the human element, is very difficult to put into scientific terms. For instance, if we watch a pair of wheel men working on the same job, we see that each of them has his own particular technique, his own particular approach to obtain the color and finish he wants. Though there have been a number of independent studies made on the subject of buffing and polishing, there is very little published data on these subjects. In several papers reported by the National Bureau of Standards Research staff[1,2,3], various references are made to the effect of basis metal conditions and buffing conditions. From these and other studies we found that there is very little consistency in the figures reported for the amount of metal removed during coloring.

In order to set an evaluation on a technique, which is as indefinite in its specification as is metal coloring, we first must determine what we mean by buffability. We may view buffing as either abrading, or as burnishing. Frequently, because buffing compounds are referred to as cut and color, coloring compounds, or simply as cutting compounds, we are apt to lose sight of the actual mechanics of buffing.

When an abrasive, carried in a vehicle which has a relatively low melting point, is applied to a surface and subsequently subjected to heat and friction from the spinning wheel, the abrasive will first of all cut the top of the facets of the metal. The heat and friction of the wheel combined, if the metal being buffed has sufficient tensile strength, cause the crystal to bend. In effect, the crystals themselves layover, presenting a continuous metal surface. This burnishing is the prime difference between electropolishing and mechanical polishing.

Frequently, in metallurgy there is an association between tensile strength and metallurgical hardness. Because of the frequency of occurrence of this relationship, we attempted to correlate the metallurgical hardness of electrodeposits and their buffability.

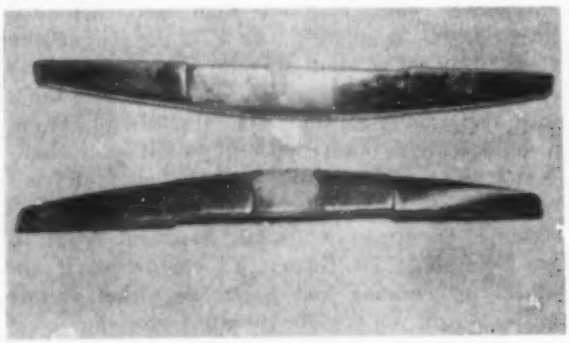

Fig. 1.
Showing how piece was cut out for photomicrograph.

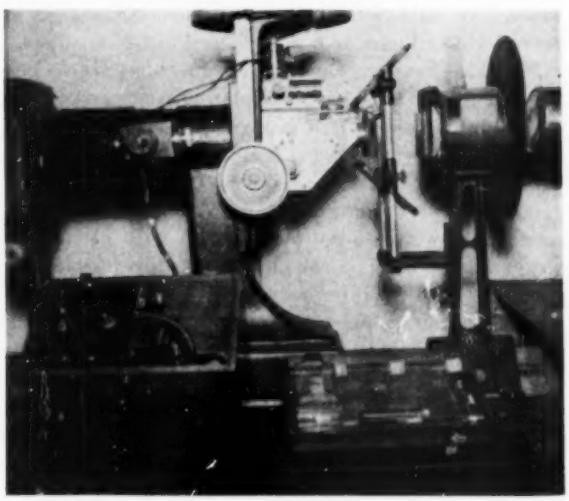

Fig. 1

*Presented at the Forty-First Annual Convention of the American Electroplaters' Society, June 13, 1954.
†Frederic B. Stevens Co., Detroit.
‡Scientific Control Laboratories, Chicago.

Fig. 3. Sample No. 2

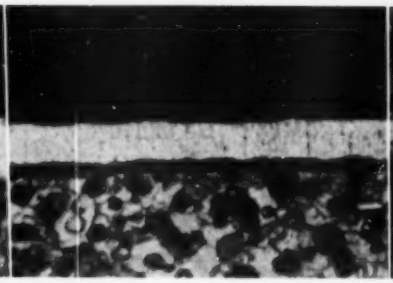

Fig. 4. Sample No. 8

Fig. 5. Sample No. 6

In order to make our study, we secured test pieces from a midwestern manufacturer (See Fig. 1). Several plating plants, using in their production a total of eight different plating baths, some proprietary, and some nonproprietary (more or less conventional), were also contacted and asked to cooperate in this study by plating samples of the test pieces in these various solutions.

There has been no intention nor attempt to rate the results which were obtained in the various proprietary baths herein reported. The reports have no bearing whatsoever on the functioning of those proprietary baths in regular production. We asked the contributing and cooperating individuals to plate our samples. We did not receive from them analyses of their solutions, nor did they furnish us with any production data concerning the solutions. Therefore, if one solution, during the course of this study, should appear to be better than another, it is not so intended. There is no attempt to convey any information other than hardness relationships.

When the plated samples were submitted, a strip of masking tape was placed over the center section of the pieces. This was done to give us a reference point for comparison of hardness in the unbuffed state. The test pieces were then taken to buffers who were asked to buff one-half, or one end of the test piece. Each buffer used sixteen-inch buffs, with spindle speeds of 1725 rpm. The buffing compounds employed were of the conventional white lime types.

Each buffer was asked to rate or evaluate the samples with respect to each other, listing them in the order, desirable buffing first and on down the list to the least desirable deposited metal.

Thus, each sample plated was buffed by two different men. The center section which had been masked by the masking tape gave us the "as plated condition," and the two buffed sections enabled us to compare not only the buffer's rating, but also the difference in burnishing effect, or hardening effect of the buffing effort by the different buffers. Feeling that the buffing of only one-half of the test piece might have given a different feel to the test piece, a second set of samples were taken to another buffing department, and in this case the buffer worked the entire surface. A comparison of the various bath results and hardness figures will be discussed later.

With regard to the choice of a method for measuring the hardness of the coating, various methods were suggested, including abrasion meters, Rockwell hardness units and Brinell machine. It must be remembered that in any penetration hardness technique, the load-thickness, or mass of material being tested, relationship has a definite limit. For example, if a deposit of 0.0005 inch of copper plated over mild steel is subjected to standard Rockwell hardness testing, the result of that measurement will not indicate the hardness of the copper, but rather will be a modification of the hardness of the basis metal.

There are two main types of microhardness testing systems. First, the Tukon, which is a direct load penetration system employing a Knoop cut diamond, and second, the indirect load type, of which there are several on the market, using a Vicker's cut diamond.

After checking various manufacturer's equipment, we selected the Eberbach microhardness unit which gives a very wide range of load values and is readily adapted to standard microscopic or metallographic equipment.

The indenter unit of the Eberbach instrument consists of a standard microscope threaded holder with a load device consisting of calibrated springs pressing against the Vicker's diamond. The microswitch is connected in series with the indenter unit. When pressure, equal to the load value of the spring, is obtained, a light in the microswitch is turned on and the operator thus knows he has reached the predetermined and calibrated load.

In all measurements, a series of three indentations are made and any results varying by more than 10 per cent are discarded. The standard formula for computing hardness is as follows:

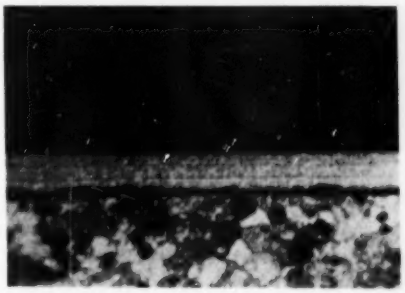

Fig. 6. Sample No. 9

TABLE I

Sample Number	Type of Bath	Thickness (Magne-gauge) Inches	Vickers Microhardness Numbers		Buffer's Ratings		
			Before Buffing	After Buffing	"A"	"B"	"C"
1	MacDermid Bright	0.00054	167P 162N	164	B	B	1
2	Unichrome Bright	0.00134	138.4	154	A	A	5
3	DuPont Hi-Speed Die Cast	0.00069	200	197	B	B	7
4A	Rochelle Still	0.00082	121	132	F	C	9
4B	Rochelle Still	0.00082	121.2	154	F	C	9
5	MacDermid (Buffing)	0.00073	128.7N 165.7P	156	A	A	3
6	Wes-X (H-VW-M) With P.R.	0.00103	169N 109.1P	199.5	D	B	4
7	Ronal (Lea)	0.00045	195.7N 209P	134	D	B	6
8	Wes-X (H-VW-M) With P.R.	0.00125	160	138	D	B	2
9	Wes-X (H-VW-M) Without P.R.	0.00145	141	192	C	A	8
10	DuPont No. 1374	0.00091	89	94.5	A	A	1
11	MacDermid Bright	0.00067	164.9	193.0 142	C	B	*1 & 6*
12	DuPont No. 1374	0.00094	128.8	177	E	B	Bad
13	Wes-X (H-VM-M) With P.R.	0.00104	200	223	C	B	*1 & 6*

EXPLANATION OF BUFFER'S RATING SCALES

Buffers "A" and "C". A Good, B Good, C Good, D Good, E Good, F Bad. Buffer "B". A Good, B Good, C Bad
Buffers reported that middle range in both scales was acceptable.

Vickers formula:

$$H = 1.8544 \frac{L}{d^2}$$

Where: H = Vickers diamond pyramid number = Vickers hardness number
L = Load in kilograms
d = Length of diagonal indentations in millimeters

Figure 2 shows the Eberbach microhardness testing unit as it was set up in conjunction with a standard Leitz metalloscope. Figures 3, 4, 5, and 6 are photomicrographs of the cross section of some of the deposits. The results of the hardness measurements, the thicknesses of the deposits, and the buffer's ratings are shown in Fig. 7.

From the tabulated results, we note that samples No. 4a and 4b, which were very coarse and appeared to be burned, had low microhardness numbers which increased after buffing, but these two samples were rated as poorest by all three buffers.

Sample No. 10 was rated best by all three buffers, yet it had a microhardness number lower than samples 4a and 4b which were very poor. In this sample, too, there was an increase in hardness as a result of buffing.

Sample No. 2 was rated excellent by two buffers and good by the third buffer. Sample No. 8 was rated as average or satisfactory. Sample No. 9 ranged from best, to middle, to poor, with no apparent explanation.

All of the buffers agree that the middle range type copper would give them no trouble in production. In other words, if they could be assured of a deposit having this characteristic they would not complain to the plating department.

Since Sample No. 2 is in this middle range, let us look at a photomicrograph of this deposit (See Fig. 3). The copper as deposited is a columnar structure copper with a fairly coarse grain. Though the grain is coarse, there is, however, good density and continuity of the deposit.

Sample No. 6, which is not as good as No. 2, has a middle range rating. It is a laminar structure. The difference in hardness, after buffing, is much greater than is the hardness, after buffing, of Sample No. 2. A marked difference in crystal structure is observed since Sample No. 6 appears to be a laminated structure.

Sample No. 8 has received a rating almost identical to No. 6, and it too has a columnar or vertical structure, but this structure is not as dense as was the structure of Sample No. 2.

Sample No. 9, again shows a laminar structure very similar to No. 6. Sample No. 9 and Sample No. 6, both of which are laminar structures, have very high microhardness numbers. No. 6 is in a middle range. No. 9 finds no similarity in the opinion of the buffers.

As a result of the studies we have made, we have determined a fact which we have known all along. We still don't know much about our field. Our original thought in the preparation of the samples and in the instituting of the project was that the harder deposits would burnish more readily, would absorb less buffing compound and hence evidence much less wheel drag.

Our findings based upon an evaluation of the samples referred to in the chart did not show that the hardest samples were the easiest to buff, nor did it show that the softest deposits were the easiest to buff.

It did show, however, that there is a surprising agreement among buffers and buffer's ratings. Even though buffing is still an art, though the compounding of buffing material is done on a scientific basis, the application and employment of the compounds is still the work of the artisan.

If we accept the fact that pressure can be reduced to a constant, we must then determine a number of other factors before we can find a true correlation of hardness and buffability.

We do not know, for instance, whether the indenter type hardness measurement is truly applicable. Does the point of the diamond cleave the intercrystalline boundary and give us an erroneous reading? Does the laminar deposit give a higher reading?

We do not know the bath conditions under which we get the different crystal structures in our deposits. In order to satisfactorily evaluate the various proprietary solutions which are referred to in this study, it would be only fair to make each bath in direct accordance with the manufacturer's specifications and to operate it in complete accordance with his recommendations. Each bath could then be checked as to the kind of deposit which it yields. Variations in these baths could be made to alter the crystal structure, then, were we to examine under the microscope the indentations themselves, we would determine whether our indenter compressed or severed the crystal structure.

If we were to carry this study on further, we should standardize our abrasive material and eliminate the possibility of human error in our evaluation. A machine for accomplishing this could be made by inserting an ammeter in series with the motor on the buffing lathe and using the load as a direct measure of the pressure involved. While results would be relative, they would at least be constant. This would give us a control on the pressures employed.

Along with controlling the pressure we could weigh the pieces before and after buffing to determine the amount of metal removed in buffing. This would give us another variable in the art of buffing. Reflectivity measurements would be of little value though a Brush surface analyzer might work to advantage.

We had a communication after the presentation of this paper in New York, from Mr. Edward R. Bowerman, who suggested that rather than attempt to correlate buffability wi'h metallurgical hardness, we might attempt to measure buffability on the basis of abradability, using the formula:

$$K = \frac{L \text{ (weight loss)}}{\sqrt{ld}}$$

Where: l = force
d = diameter of rod used

There is much to be said in favor of a correlation of abradability with buffability but abradability also is related to hardness, which keeps us in the same question of "Is there a correlation of metallurgical hardness to buffability?" We believe that there is, but it is going to take extended research in order to prove it and determine the exact correlation.

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DISCUSSION

MR. A. H. DUROSE (Harshaw Chemical, Cleveland, O.): I would like to ask the speaker if any allowance was made for the surface texture of the finishes—in other words, don't you believe that surface texture would be as important as hardness, and is there any possibility that the hardness as measured after buffing varied because of the different thicknesses?

MR. MODJESKA: In the first question, undoubtedly the surface condition of the deposit is a big factor. A matte porous appearing deposit naturally appears to dry buffing compound. When the piece gets loaded with compound the buffer has to work longer to take the imbedded compound out of the surface. That is why I commented on samples 4 A and B, because they looked so bad.

In making the hardness measurement of a semi-lustrous deposit as compared with a matte deposit, we come into that question of whether we are shoving the particles aside or whether we are compressing them.

One thing more that we have done in an attempt to take some of the human element out is to put in a pressure measurement on our buff and in this first study, the buffers each exerted their normal pressures. We had no quantitative measure of relative pressures used by the buffers. For laboratory purposes it is possible to measure the pressure requirements under surface conditions.

VARIABLE ELECTRODE RECIPROCATOR

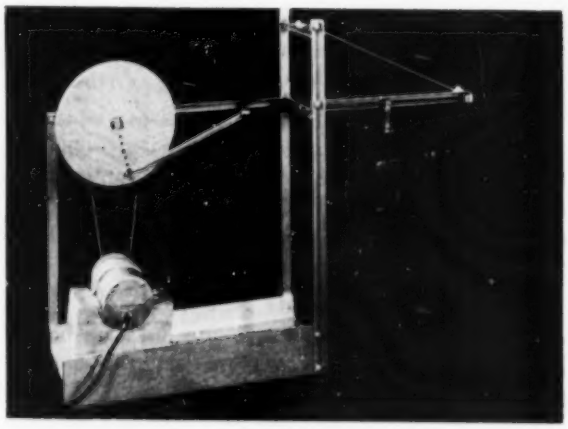
K. A. VAN LENTE AND E. H. HADLEY*

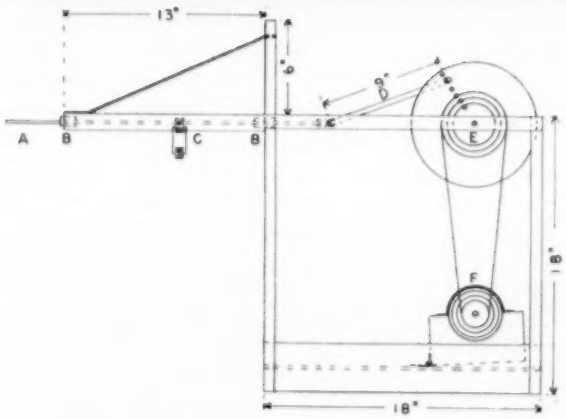
In connection with some experimental electroplating, this machine was developed to move one electrode through the plating solution while the other electrodes were held stationary.

The base of the machine is a piece of 6-inch I beam to have stability. The structural members are $\frac{3}{4}$ x $\frac{3}{4}$ x $\frac{1}{8}$-inch angle irons, except the extension arm, which is of 1 x 1 x $\frac{1}{8}$-inch stock. This arm is set high enough to allow the plating bath on a gas plate to be placed beneath the arm. The sliding rod (*A*) is a piece of $\frac{1}{4}$-inch cold rolled steel 23 inches long with a coupler screwed to one end. The electrode holder (*C*) is positioned on the rod by means of a set screw, and the strip of wood insulates the machine from the electrode. The wheel and pulleys were made of pieces of $\frac{3}{8}$-inch plywood, glued together and turned to size.

The cylindrical motor (20 r.p.m.) was taken from a Hamilton Beach Iceless Freezer (Racine, Wisc.). It is mounted on a wooden block, which is hinged to the webb of the I beam so that proper tension can be maintained on the nylon belt. Distances and rates of electrode travel can be varied by attaching the connecting arm to different holes in the wheel and by changing the belt on the three-step pulleys. As constructed, the variation is in steps from approximately 27 inches per minute with a $1\frac{3}{4}$-inches stroke to 331 inches per minute with a $7\frac{5}{8}$ inches stroke. The machine was used mostly with a rate of about 105 inches per minute and a $6\frac{3}{4}$ inches stroke.

It is conceivable that this machine could be used advantageously for other purposes such as various forms of agitation.





A, sliding rod; B, bronze bushings; C, electrode holder with a wooden strip separating the two metal ends; D, aluminum strip connecting arm; E, 8¼ inch diameter wheel with a 3-step pulley (diameters: 4½ inch, 3¾ inch, 3 inch); F, 3-step pulley (diameters: 3¼ inch, 2½ inch, 1¾ inch) mounted on the motor shaft

*Southern Illinois University, Carbondale, Illinois

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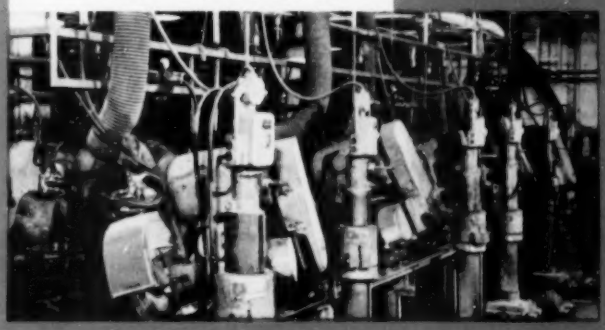

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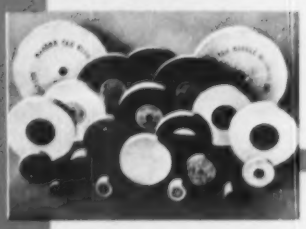

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Barrels, Tumbling
Barrels, Plating
Basket, Scrap Anode
Baskets, Dipping
Brighteners, Addition Agents
Brushes
Buffs
Cathode Rockers
Chemicals, Plating
Chrome Spray Floats
Cleaners
Compositions
Conveyors, Full-Automatic
Conveyors, Semi-Automatic
Cooling Coils
Crocks, Earthenware
Degreasing Solvents
Dryers
Exhaust Fans
Filters
Felt
Fluxes
Generators
Gloves, Platers'
Glue, Belgrade
Heaters
Heating Coils
Hose
Insulating Steam Joints
Klinch Grain Cement & Thinner
Kote-Masq
Kote-Rax, Grade L
Lathes
Lime
Moisture Extractor Equipmet
Oxidizing Liquid
Pails, Rubber
Paint, Tygon Plastic
Periodic Reverse Control
Pipe & Fittings, BN
Purification Supplies
Rectifiers
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1227

BRASS PLATING*

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In spite of the difficulties inherent in alloy deposition and the wide divergence in the normal potentials of copper and zinc, the deposition of brass has been practiced for many years. This is probably due to the early advent of cyanide solutions in the plating field. Most of the brass plating, however, has been for decorative purposes where appearance of the deposit is of prime importance and composition of deposit of little consequence. The use of brass plating for the purpose of bonding rubber to metal, which developed at a later period, requires a very close control of composition, and color is not as important nor can it generally be used as a guide to the composition. For this purpose, the composition of the deposit that is required depends on numerous factors in the vulcanization process, but it generally falls in the range of 65 to 75 per cent of copper. Since the items to be bonded are often complex in shape it is usually difficult to deposit brass of uniform composition on all surfaces. The purpose of this study was to develop brass plating solutions producing deposits ranging between 65 and 75 per cent of copper with a minimum variation of composition with current density.

According to Faust,[1] electroplating of brass was accomplished as early as 1841, and numerous papers have been written on the subject. Most of the early solutions were not prepared from metal cyanides and the purity of the salts used was questionable. Therefore, it is not surprising that most solutions were operated at low current densities.

Field[2] used higher current densities, but he also employed agitation and higher temperatures than most other investigators of this period. The solutions used varied a great deal in their copper-zinc ratios, some of them containing more zinc than copper and vice versa. Since many of these solutions were prepared from carbonates or had carbonates added, the *p*H was probably low.[3,4,5,6]

The measurement and to some extent the control of *p*H dates back to about 1938.[7,8,9] At this time some difficulty was experienced in plating in the *p*H range between 10.3 and 12.5, which Meyer[8] attributed to impurities in the commercial salts.

Pan[10] reported on the beneficial influence of ammonia in brass baths, which resulted in a uniform color of deposit over a wide range of operating conditions. Unfortunately, despite the uniform color, the composition was variable and generally low in copper, making the product from such solutions (containing ammonia) unsuited for rubber bonding.

The earliest comprehensive study of brass plating for rubber adhesion is probably that of Coats[5], who studied the effects of various additions and conditions on the composition of the deposit and the adhesion of rubber. Substitution of amines for ammonia in brass baths was investigated by Clarke, Bradshaw, and Longhurst,[11] and it was found that monoethanolamine was satisfactory and permitted operation at higher temperatures. Kronsbein and Smart,[12] starting with the white brass solution of Oplinger[9] but omitting the sodium hydroxide, developed a solution capable of operating satisfactorily at 20 amperes per square foot and depositing coatings much thicker than normally employed (0.0063 inch).

Electrodeposited brass exhibits the same phase structure as cast brass,[13,14] although the locations of the phase boundaries are not exactly identical. The color also differs from that of cast brass of corresponding composition and varies with conditions of deposition.

The composition of brass best suited for rubber adhesion depends on many factors, including the sulfur content of the rubber, the accelerator content, the conditions of curing, and the cleanliness of the brass surface.[15-23] The optimum composition generally falls between 65 and 75 per cent copper but sometimes is as high as 85 per cent. The essential bonding reaction is considered to be due to the sharing of a sulfur atom by both metal and rubber, and there is strong competition between the rubber and the metal for the available sulfur. Rubber compounds containing rapid accelerators generally react with sulfur so fast that a higher copper brass is required. Some accelerators, probably due to the adsorption on the metal surface, inhibit bonding completely.

While the theory of alloy deposition has been discussed in numerous publications and is generally

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*Presented at the Forty-First Annual Convention of the American Electroplaters' Society, 14 July 1954.

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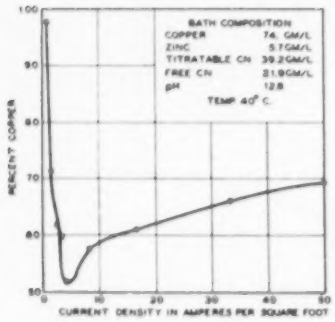

Fig. 1. Typical variation of composition with current density

agreed upon, the application of the theory to the development of an alloy bath is complicated by so many variables that "Virtually all alloy plating that is conducted commercially, especially brass plating is based on empirical study and not upon any far-reaching predictions derived from theoretical considerations."[24]

The theory is useful, however, as a guide in planning experiments and in interpreting results. The essential requirements are that the deposition potentials of the metals involved be close to each other and that their cathodic polarizations be such that both can be deposited in the desired ratio at the same cathode potential. In the case of brass plating, cyanide solutions have proven to have these properties and are generally used.

Fields[2] commented on the fact that cyanide reverses the polarity of a Daniell cell, indicating that zinc in cyanide solutions could be more noble than copper. Bennett and Davison[3] were unsuccessful in their attempt to deposit brass out of solutions other than cyanides, although with proper control it could probably be accomplished.

In order to deposit brass of constant composition at varying current densities the shape of the cathode potential-current density curves and the cathode efficiency must be controlled in a very definite manner. In the case of alloys in the range in which we are interested, they must be nearly identical since half of the current used to deposit metal will deposit copper and half zinc when the composition is 66 per cent copper. This implies that the degree of ionization and the ionization rate and diffusion rate of both metals and hydrogen must all be balanced over a wide range of current densities. This does not seem to be possible at low current densities, and consequently low polarization, and our experiments show considerable variation in this area. Figure 1, which is a typical current density composition curve that is also tabulated in Table I, shows that at current densities near zero the composition of the deposit usually approaches pure copper and that as the current density is increased the composition falls to a low copper value and then increases to a fairly constant value at higher current densities. Similar curves have been published by Raub and Kraus,[13] who used highly alkaline solutions in order to deposit high zinc alloys, and are indicated in part by the curves published by Field.[2] Most solutions used for brass plating are used at low current densities and low metal concentrations and are subject to variation of composition with current density and probably would not be capable of plating at higher current densities due to their low metal content. It can be seen from Fig. 1 that uniform deposits can be obtained over a wide range of current densities if sufficient metal is present and the current density is high enough. It should be realized, however, that as the current density is increased the efficiency of metal deposition decreases.

TABLE I. TYPICAL VARIATION OF COMPOSITION WITH CURRENT DENSITY

CD A/ft²	Per cent Cu	CD A/ft²	Per cent Cu
0.83	97.6	8.3	57.5
1.7	71.2	16.7	60.8
2.5	61.6	33.3	65.9
3.3	59.8	50.0	69.4
4.2	51.7		

Bath Composition (54/4)

Copper	74
Zinc	5.7
Titratable CN	39.2
Free CN	21.9
*p*H	12.8

Temperature 40° C

The co-deposition of hydrogen complicates the situation in the cathode film, and Raub and Kraus[13] feel that the minimum in the current density composition curve is at the current density at which hydrogen deposition begins. The shape of the curve in the low current density area may explain why there is some difference of opinion as to the effect of current density on composition. At low current densities there is very little polarization except in extremely dilute solution, and any influence that may disturb the metal ion concentration of the cathode film will have a marked effect. In the initial stages of deposition, as the cathode film is increasing in thickness, the composition of the deposit probably simulates the current density-composition curve, starting at high copper and decreasing in copper and again increasing in copper to the equilibrium value for the current density used. This would explain the difference in composition between initial and subsequent deposits observed by Coats[5] and Kronsbein and Smart[12] and in the variation of color of deposit with time that is often observed. The deposits used in this work are all in the order of 0.2 of a mil thick in order to minimize this effect.

From the shape of the current density-composition curve it is obvious that a bath plating the desired composition at low current densities would deposit too much copper at the higher current densities. The zinc content of the deposit can be increased by increasing the zinc content of the bath which also may,

by dissociation and common ion effect, decrease the ionization of copper, but it was felt that the zinc content should be increased by raising the *p*H since this would not appreciably influence the behavior of the copper. In a sense this is similar to the use of *p*H to control the tin in a copper-tin bath where the copper is complexed with cyanide and the tin with caustic In the brass solution the zinc is also complexed by the cyanide, but it was felt that at higher *p*H this effect would be minimized. Addition of cyanide in high *p*H baths does not suppress the deposition of zinc as much as that of copper so that increasing the cyanide would also increase the zinc content of the deposit. This permits the use of a bath of higher copper concentration and decreases the sensitivity of the solution to variation in copper content.

Since the distribution of zinc between zincate and cyanide complex may vary and liberate cyanide which would complex the copper, particularly in the cathode film, increasing the total cyanide should minimize the effects due to small variations in the cyanide content. Although increasing the cyanide content decreases the cathode efficiency, it permits the use of higher current densities which more than compensate for this effect.

The chemistry of the brass plating bath consisting chiefly of cyanides and zincates is exceptionally complex. Numerous complexes of copper and zinc with cyanide exist, particularly in baths containing an excess of cyanide.[25–30] The copper cyanide complex is considered to be more stable than the zinc since in alkaline solutions zinc can exist as the zincate as well as the cyanide complex. This complicates the analysis of brass baths and confuses the results of many early studies where the variables, particularly alkalinity, are not reported. It is not possible to determine free cyanide in a zinc bath since the zinc cyanide complex can release more free cyanide as the titration proceeds. Consequently in the analysis of the baths used, the titratable cyanide in the presence of excess caustic was determined and the sodium cyanide equivalent to that necessary to form $Na_2 Zn (CN)_4$ was subtracted from the titratable cyanide to give the "free" cyanide. Although it is realized that the ratio of zin-

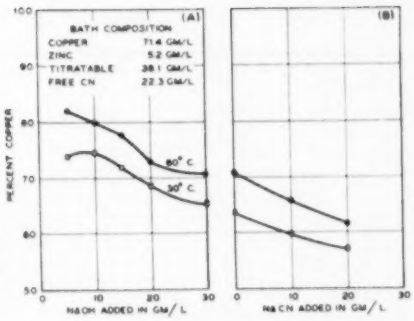

Fig. 2. Left: Variation of composition with alkalinity. Right: Solution from (a) with NaCN added

TABLE II. VARIATION OF COMPOSITION WITH ALKALINITY

	30° C			60° C		
A/ft²	8	25	50	8	25	50
NaOH added, gm/l		Per cent Cu			Per cent Cu	
5	64.3	71.4	73.8	62.8	80.5	82.0
10	62.3	73.0	74.5	66.0	77.9	79.9
15	63.4	66.0	71.8	63.2	74.5	77.6
20	62.8	63.5	68.5	58.3	69.8	72.8
30	57.3	63.8	65.2	—	65.6	70.6

Bath Composition (gm/l)

Copper	71.4
Titratable CN	38.1
Free CN	22.3

TABLE III. EFFECT OF CYANIDE IN ALKALINE BATH
(Solution from Table II with NaCN added)

	30° C			60° C		
A/ft²	8	25	50	8	25	50
NaCN added, gm/l		Per cent Cu			Per cent Cu	
0	56.6	64.2	63.5	58.8	67.9	70.9
10	54.1	59.2	59.6	56.4	62.6	65.6
20	53.5	49.3	57.0	54.5	56.8	61.5

TABLE IV. COMPOSITION VS CAUSTIC AND CYANIDE

	30° C			60° C		
A/ft²	8	25	50	8	25	50
Addition, gm/l	Per cent Cu			Per cent Cu		
0	82.0	94.3	92.0	89.5	——	97.5
*NaOH 10 g/l.....	91.6	94.6	94.5	96.2	96.2	97.3
NaCN 20 g/l.....	65.4	71.9	77.5	65.6	83.2	86.9
NaOH 20 g/l (total)	58.5	68.8	72.1	63.6	72.8	74.4
NaOH 30 g/l (total)	59.4	62.2	69.9	68.8	68.0	74.1
NaOH 40 g/l (total)	59.5	65.5	67.4	63.2	67.7	69.5
NaCN 30 g/l (total)	54.8	59.4	64.6	60.1	63.4	66.8
NaCN 40 g/l (total)	53.8	57.2	58.7	57.4	60.4	62.4

Bath Composition (gm/l)

Copper	66.7
Titratable CN	18.7
Free CN	2.6
*p*H (initial)	10.6

*Solution became cloudy CN insufficient.

cate to cyanide complex is higher in alkaline solutions, the "free" cyanide was kept constant when the zinc concentration was varied in any particular set of experiments. The determination of *p*H in these alkaline solutions was not too satisfactory due to the high sodium error of the glass electrode, the slow rate of *p*H change with added caustic at the higher *p*H values, and particularly to a slow drift during the measurement. Consequently a convenient method of titrating "free" caustic was required, and a variation of the method of Silverman[31] was adapted. In the initial experiments the "free" caustic was not determined since general trends were being surveyed and the amount of caustic added was known. The methods used for analysis of the deposits and solutions are given in the Analytical Appendix.

In the present study the following variables were investigated: *p*H, temperature, free cyanide, metal content, and metal ratio. Exploratory studies at 50 A/ft² confirmed that increasing the alkalinity increased the zinc content of the deposit and increasing temperature increased the copper content.

Since we were interested in control of composition, most experiments were conducted at relatively high current densities and relatively high concentrations of free cyanide and higher *p*H. All of the solutions used had a volume of 10 liters since it was desired to maintain reasonably constant bath composition. The baths

TABLE V. SOLUTION COMPOSITION FOR STUDY OF INFLUENCE OF METAL CONTENT AND RATIO

Composition (gm/l)

Bath	Cu	Zn	Cu/Zn	Titr CN	Free CN
A1	49.5	2.4	20.6	32.2	25.0
A2	48.7	4.0	12.2	37.0	25.0
A3	47.9	4.7	10.2	37.2	23.1
B1	58.3	3.0	19.4	33.2	24.2
B2	60.5	4.3	14.1	36.0	22.0
B3	58.9	5.3	11.1	40.4	24.4
B4	60.1	7.5	8.0	46.5	24.0
C1	67.2	3.6	18.7	27.0	25.0
C2	70.2	4.9	14.3	37.6	22.9
C3	70.5	6.0	11.7	43.9	26.0
C4	68.6	8.7	7.9	49.0	24.3
C5	66.4	15.9	4.2	72.0	24.4

20 gm/l NaOH added Free CN held at 25 g/l, and Titratable CN depends on ZN concentration

were thermostatically controlled, and the cathodes were 2 x 3-inch mild steel panels.

In the first series of runs (Table II) the effect of increasing alkalinity on the composition was determined at 30° C and 60° C and the values for 50 A/ft² plotted (Fig. 2A). It can be seen that increasing the alkalinity decreases the copper content of the deposit. Addition of cyanide to this solution (Table III and Fig. 2B) results in a further decrease in the copper content.

In the next series (Table IV) the initial bath was the same except that it had a very low free cyanide content, and the deposits were very high in copper. After an initial addition of sodium hydroxide the bath became cloudy and apparently precipitated zinc since the deposits became higher in copper. It was necessary to add cyanide to clear the solution, which resulted in a lower copper content. Further additions of caustic and cyanide confirm the results of the first series.

A series of baths having copper contents of 50, 60, and 70 gm/L and varying amounts of zinc were run (Tables V and VI) in order to determine the effect of metal content and ratio, while maintaining the same amount of added caustic and free cyanide. The results of this series indicates that satisfactory compositions (65–75 per cent Cu) can be obtained over a wide

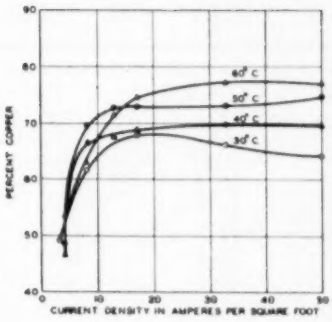

Fig. 3. Composition versus temperature and current density

TABLE VI. COMPOSITION VS METAL CONTENT AND RATIO

		30° C			60° C		
A/ft²		8	25	50	8	25	50
Bath	Ratio	Per cent Cu			Per cent Cu		
A1	20.6	66.8	70.9	72.6	73.9	78.0	80.4
A2	12.2	58.4	62.5	63.9	69.8	70.6	73.5
A3	10.2	57.5	61.6	63.6	51.5	72.2	75.5
		(Copper 50 gm/l)					
B1	19.4	72.6	76.8	78.2	84.5	84.5	87.2
B2	14.1	69.2	69.7	74.5	84.0	83.2	84.2
B3	11.1	64.1	67.9	68.5	80.4	80.0	82.5
B4	8.0	62.8	58.9	64.3	78.2	78.2	78.9
		(Copper 60 gm/l)					
C1	18.7	69.2	74.8	77.8	77.9	80.3	82.2
C2	14.3	65.4	71.9	72.3	69.5	78.0	80.0
C3	11.7	61.8	67.9	68.5	57.9	76.0	78.5
C4	7.9	62.8	66.2	68.5	58.1	76.0	78.5
C5	4.2	61.8	64.4	64.0	58.8	74.6	76.0
		(Copper 70 gm/l)					

TABLE VII. COMPOSITION VS TEMPERATURE AND CURRENT DENSITY
(Bath C5 Table V)

A/ft²	3	4	8	13	17	33	50
° C	Per cent Cu						
30	49.3	——	61.4	——	67.8	65.9	64.2
40	——	46.6	66.3	67.4	68.8	69.8	69.6
50	——	48.5	69.7	72.9	73.0	73.2	74.7
60	——	53.5	62.9	71.5	74.5	77.1	77.0

TABLE VIII. COMPOSITION VS *p*H INCLUDING HIGHER CURRENT DENSITIES

CD A/ft²	8	25	50	75	100	125
*p*H	Percent Cu at 30° C					
10.8	82.2	83.5	78.5	75.5	73.5	73.1
11.3	66.9	71.0	71.2	71.2	70.0	68.4
11.9	60.8	62.6	63.8	65.4	66.1	66.5
12.2	53.3	57.7	56.7	58.5	59.4	59.8
12.8	40.4	45.6	45.7	45.6	46.0	45.8
	Per cent Cu at 60° C					
10.8	73.2	90.6	92.5	91.4	85.0	87.9
11.3	47.8	81.4	83.5	83.8	83.1	82.0
11.9	48.2	72.1	72.2	72.9	72.5	72.6
12.2	46.5	60.5	61.9	62.5	63.2	63.9
12.8	36.1	39.0	49.0	49.5	48.1	49.6

Bath Composition (gm/l)

Copper	70.4
Zinc	17.3
Titratable CN	76.6
Free CN	24.7

range of concentrations but that the higher metal content baths showed less variations of copper content of the deposit.

Using the last bath of the previous series, a set of runs was made at 30°, 40°, 50°, and 60° C (Table VII and Fig. 3). This shows that uniform brass deposits of any desired composition between 65 and 75 per cent Cu can be obtained by controlling the temperature, the variation due to current density being reasonably low.

Since the baths employed are quite high in metal content it was felt that the current density could be further increased. A series of experiments run at different *p*H and higher current density (Table VIII) proved that the composition was reasonably uniform and the copper content decreased with increasing *p*H as before.

Since the determination of *p*H is not always satisfactory, another series (Table IX) was run in which the sodium hydroxide was titrated (see Analytical Appendix). The *p*H was also measured, and this series confirms the previous one.

The bath finally selected for general brass plating for rubber adhesion was a high copper bath similar to bath C5 (Tables VI and VII) since the higher metal content solutions show less variation in composition

TABLE IX. COMPOSITION VS TITRATED CAUSTIC

CD A/ft²	8	25	50	75	100	125
NaOH (gm/l)	Per cent Cu at 30° C					
2.7	84.4	84.9	80.6	75.6	72.6	70.5
5.6	78.8	77.8	69.3	73.5	73.4	71.4
9.4	63.2	65.2	65.0	64.8	66.0	66.5
	Per cent Cu at 60° C					
2.7	93.0	94.8	90.6	93.4	91.5	90.0
5.6	81.5	90.3	90.3	89.2	87.2	86.7
9.4	76.3	77.2	78.0	78.5	76.9	72.3

Bath Composition (gm/l)

Copper			68.1
Zinc			16.0
Titratable CN			72.0
Free CN			24.0
NaOH added (gm/l)	0	2	8
NaOH titrated (gm/l)	2.7	5.6	9.4
*p*H	10.8	11.4	11.8

TABLE X. COMPOSITION VS CURRENT DENSITY IN RECOMMENDED SOLUTION

A/ft²	25	50	75	100	125
Per cent Cu (30° C)	62.8	62.6	62.2	62.4	61.5
Per cent Cu (60° C)	74.6	76.3	76.1	76.1	75.1

Bath Composition (gm/l)

Copper	70
Zinc	10
Titratable CN	56
Free CN	28
Titratable NaOH	11
*p*H	12.2

of deposit with variations in bath composition. Although baths operated at higher *p*H give less variation of composition with changes of operating temperature and might be ideal for some purposes, especially since the *p*H would probably be more stable, it was felt that our purpose would be better served by a bath of moderately high *p*H. This permits altering the composition and thus obtaining a range of composition to be used in studying the "bonding" behavior of a given rubber-vulcanizing system. Consequently a *p*H of 12.2 was selected, which gives a composition range between 62 and 76 per cent copper over a temperature range of 30° to 60° C as shown in Table X. Since the bath is operated at a high *p*H and elevated temperature no ammonia has been added nor does it seem to be necessary.

Since it is sometines desirable to plate on wire and strip and other moving cathodes, a series of experiments was run on cathodes rotating at different speeds (Table XI). At low current densities (50 A/ft²) and higher speeds of rotation the copper content of the deposits was very low, indicating that the current density-composition curve has been shifted by increased agitation so that the low copper portion of the curve occurs at higher current densities. Since, however, the current density can be increased appreciably with increasing agitation, no difficulty should be experienced in obtaining satisfactory deposits.

All of the deposits obtained in these experiments were sound metallic deposits of good appearance, although the lower current density deposits were more matte. At the high copper contents the deposits were coppery in color, but in the desired range (65–75 per cent) they were quite uniform yellow deposits and very little difference in color could be detected, using a Hunter Color Difference Meter. At the lower copper contents the deposits varied from pink to light gray or lavender. Hull Cell test panels gave a uniform color except on the back where the current density is extremely low.

The cathode current efficiencies were naturally not high being between 25 and 50 per cent, but this is amply compensated by the high current densities employed. A coating 0.0002 inch thick could be applied in 3 to 6 minutes, and all of the coatings tested were in this range, which is relatively thick for brass plating. Since it is not difficult to produce these relatively thick deposits and it is known that the composition of thin deposits is variable, particularly when

TABLE XI. EFFECT OF ROTATING CATHODE ON COMPOSITION

rpm	0	900	5,000	15,000
A/ft²	Per cent Cu at 30° C			
50	57.4	70.6	25.8*	24.1*
150	68.5	70.6	72.6	70.5
300	65.9	68.2	71.5	70.0
450	64.8	66.5	72.0	72.9
	Per cent Cu at 60° C			
50	66.5	38.8*	32.6*	33.0*
150	72.4	62.2	53.5*	33.0*
300	76.3	71.0	71.2	60.9*

*Color pale yellow to white

Same bath as Table X, and cathodes ¼ inch rod x 6 inches

deposited on different base metals, it is easier to control the deposit composition by plating test deposits on steel panels from which the sample can be readily stripped and analyzed and then, having obtained the desired composition, to deposit brass of the same thickness on the desired base metal, which is sometimes a copper alloy on which the analysis of the deposit is impractical.

It has been our practice over a period of years of using the same bath to produce deposits of various compositions for bonding to different rubber compounds by running test panels at various temperatures and then by interpolation to select the temperature yielding the desired composition. This eliminates the need for analyzing the bath and making minor corrections in composition from day to day. When the bath has altered measurably in composition it is, of course, corrected, but we have found that brass baths do not come to equilibrium rapidly, and consequently we would rather alter the temperature to obtain a desired result since this can be done more rapidly.

The baths developed in this study should be ideal for production brass plating for rubber adhesion because their high concentration of all components makes them less susceptible to variation. The uniformity of composition with varying current density makes them ideal for plating on complex shapes, and the control of composition by varying the temperature gives them a great degree of flexibility where different compositions are required and minimizes analytical work where it is desired to maintain a desired composition. The good uniform color of the deposits over a wider range of operating conditions and the ease of obtaining thicker deposits, which would eliminate a common criticism of brass plating, makes these baths ideal for decorative brass plating.

Acknowledgment

The assistance rendered by other members of the staff of the Bell Telephone Laboratories is gratefully acknowledged.

Analytical Appendix

Bath Analysis

Copper: 10 ml of solution was acidified to destroy cyanides and the copper plated out on a platinum electrode and weighed.

Zinc: The solution from which copper had been removed was titrated with ferrocyanide, using ferricyanide and diphenylamine as an internal indicator. (If iron is present it must be removed prior to titration of zinc.)

Titratable cyanide: 10 ml of solution was diluted to 70 ml and 10 ml of 10 per cent potassium iodide solution and 3 grams of sodium hydroxide were added. The solution was titrated to permanent turbidity with silver nitrate. If the solution was very high in zinc a 5 ml sample was used and 5 grams of sodium hydroxide were added.

Free cyanide was determined by subtracting the cyanide equivalent to the zinc from the titratable cyanide one gram of zinc being equivalent to 3 grams of sodium cyanide.

Free caustic: To 10 ml of solution add 25 ml of saturated barium chloride, 150 ml of alcohol and a few drops of thymolphthalein (original method used phenolphthalein but thymolphthalein gives a better end point). Titrate with N/2 hydrochloric acid. This method gives a blank titration of 2 to 3 ml, using a solution to which no sodium hydroxide has been added, but if this is subtracted from the titration, fair agreement is reached between added caustic and titrated caustic. The following table shows the relation between the added caustic, titrated caustic, and *p*H:

NaOH added g/l							
0	5	10	15	20	25	30	40
NaOH titrated							
2.3	8.4	13.2	17.6	24.4	27.9	33.3	44.7
NaOH corrected							
0	6.1	10.9	15.3	22.1	25.6	31.0	42.4
*p*H							
11.5	12.2	12.4	12.5	12.4	12.9	13.04	

Deposit Analysis

The brass was dissolved from the weighed steel panel using a mixture of approximately five grams of ammonium persulfate and twenty ml of ammonium hydroxide diluted to a hundred ml with water. The solution was boiled to destroy the persulfate, acidified with nitric and sulfuric acids, and the copper determined by electrolysis. The zinc was determined by difference.

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DISCUSSION

DR. F. A. LOWENHEIM (Metal & Thermit Corporation, Research Laboratory, Rahway, N. J.): You know the question I am going to ask—you have investigated all the variations except the substitution of potassium for sodium. Does that have any effect on the efficiency and constancy of the deposition?

MR. EHRHARDT: As I said, we have not done it. I think we did make up a potassium bath—I think your general assumption would be correct—it would be equally good if not better. I think that this is generally true.

DR. DODD S. CARR (Bart Laboratories Co., Inc., Belleville, N. J.): Can you tell us in a few words about the composition required as a function of the sulfur content of the rubbers that you were curing on the brass?

MR. EHRHARDT: Well, I could, but it would not be very much. Generally we leave that up to the rubber chemist. There are some references in the paper to that point. It depends on the sulfur content and it also depends on how fast the sulfur-rubber reaction is over and how fast the sulfur-brass reaction is over.

DR. CARR: Supposing that you have a constant sulfur content.

MR. EHRHARDT: You want to know the effect? If your copper is high you get a fast development of adhesion because you get a heavy copper sulfide film, but it is brittle and your adhesion is not as good. If you are on the low side in copper, you do not get the maximum adhesion occurring immediately, but it builds with time, so that it is safer for most purposes to be a little on the low side. However, when you are vulcanizing wire at several hundred feet a minute and want the rubber to adhere to the wire before it hits the gland at the end of the vulcanizing chamber, there we would also rather have the adhesion fail later so that you can strip the wire. We are not interested in permanent adhesion in this case and a higher copper alloy is used.

MR. FRANK A. TRUDEN (Crosley Division, AVCO, Nashville, Tenn.): Have any studies been made as to the effect of brass plating as a base for metal bonding with cycleweld or similar adhesive methods.

MR. EHRHARDT: I think, generally speaking, those things are competitive and now that we have a brass bath for rubber adhesion we do not use it as much as when we started to develop it, because other processes have come in. It depends a lot on what you are doing. I don't think brass is specifically designed for cycleweld and some of the other processes, but some of the synthetics, some of the elastomers used today are not really rubber and don't use sulfur, and if they do not use sulfur, I don't think there will be any reaction with the brass, and I don't think you will gain anything.

MR. E. B. WASHBURN (McKinney Mfg. Company, Pittsburgh, Pa.): Have you been able to do barrel plating and get controlled deposits with your formulation?

MR. EHRHARDT: No, we did not. As a matter of fact, I omitted the last slide which was the effect of agitation on the composition. It has the same effect as reducing the current density. The agitation shifts the curve toward the low current density end, if at the same time you increase the current density solution you compensate—in other words, you get satisfactory brass. I think it could be done, but I think you would have to formulate for that particular use.

DR. A. K. GRAHAM (Graham, Crowley, and Associates, Inc., Jenkintown, Pa.): I would like to ask whether the bath composition which you have settled on for rubber adhesion has been used by you for decorative plating?

MR. EHRHARDT: No.

DR. GRAHAM: In presenting the paper I understood you to say that the bath composition you have used for rubber adhesion can be used for decorative brass plating. I would question that this would be practical for the following reasons:

(*a*) Present decorative bath compositions give efficiencies from 85 to 95 per cent at current densities from 5 to 25 amp/sq ft. The higher current densities mentioned in your paper are of little value for decorative plating, especially with an efficiency of 50 per cent.

(*b*) Much lower total metal concentrations are preferred, and under these conditions lower copper-zinc ratios are also preferred in order to obtain good control of both the color and composition of the deposit within the range of conditions mentioned.

On the other hand, the conditions which you outlined for deposits for rubber adhesion offer decided advantages over what has been known heretofore. I wish to congratulate you on your paper.

THE THROWING POWER OF TIN AND TIN ALLOY PLATING SOLUTIONS*

FREDERICK A. LOWENHEIM†

Every plater knows intuitively what is meant by throwing power but the precise definition of this property has posed problems which have not been completely solved; nor does this paper pretend to offer a solution. There are two principal difficulties with the precise formulation of the concept of throwing power.‡

(1) Anything which can be defined should be capable of being measured. The quantitative measurement of a property which can be called the tp of a solution has been the subject of a great deal of effort but no thoroughly satisfactory answer has been found.

(2) There is confusion between tp and another related but not identical property called covering power. Many platers speak of a solution's ability to "throw" into the bottom of deep recesses, to plate the interior of long tubes, etc., and this property is taken as a measure of the tp of the solution. This is actually a measure of covering power; it has never been shown that covering power and tp are quantitatively related, even though in general they do seem to go along together.

Covering power, however, seems much more likely than tp to be a function of extraneous factors having nothing to do with the solution itself; thus it is well known that some basis metals are easier to cover than others, due to such things as passivity or lack of it, or hydrogen overvoltage on the particular basis metal involved. Thus for example it is common practice to flash malleable iron with tin before zinc plating to improve the coverage of the zinc in recesses. This depends on the fact that the hydrogen overvoltage is higher on tin than on iron.

There have been many attempts to measure tp quantitatively and to express it as a definite property of a solution, like its cathode efficiency or its pH. All such attempts have failed of their total objective for reasons which will appear; but nevertheless they do have value in a qualitative sort of way, and provided the investigator is not misled into claiming a high degree of precision for his results they do have meaning.

Tp is generally defined as the improvement in metal distribution on a cathode over the primary current distribution. In other words if one part of a cathode receives twice as much current as another but only 50 per cent more deposit, the solution is said to show good tp; if the metal distribution is the same as the current distribution—twice as much in our hypothetical case—the tp is said to be zero; and if the high current areas receive say three times as much deposit as the low, the tp would be negative. Solutions of all types are known.

So far so good; the trouble comes in trying to give mathematical meaning to this concept and to formalize the definition so as to be able to say that a given bath has a tp of so many percent. Also we should like to be able to measure this quantity so that we can study in the laboratory the effect of variables; if the tp of a nickel bath is 15 per cent, what effect does a change in *p*H have or metal content or any other variable?

The tp of a solution is the combined result of a great many factors; it is this fact as much as anything else which causes the difficulty in measuring it. Tp is actually not an inherent property of a given solution, that is, but the resultant of many properties. The difficulty really starts at the definition; it has been said that tp is the improvement in metal distribution over primary current distribution. How does one measure primary current distribution? The calculation of current distribution in any but the very simplest geometrical systems is extremely difficult. Even assuming the current distribution is known from geometry, the actual current distribution will be different because polarization will usually be higher at high current density points and so the so-called secondary current distribution will be more favorable than the pure geometry of the system would predict. The conductivity of the solution enters in, because in a solution of high conductivity the polarization resistance is proportionately more important than when ohmic resistance is high, as it is in solutions of low conductivity. Agitation which is violent enough to cause breakdown of the cathode film will interfere with the

*Presented at the Forty-First Annual Convention of the American Electroplaters' Society, 15 July 1954.
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‡Abbreviated tp hereafter.

polarization effects already mentioned. Very important is the shape of the current density–cathode efficiency curve. If the cathode efficiency falls as the cathode current density rises, less metal will deposit on high cd areas than would otherwise be the case and metal distribution will therefore improve. All these factors, and perhaps others, have to be taken into account in attempting to predict or explain the tp of a given solution. But these factors do not all work in the same direction; some are at cross purposes with others. It has been attempted to predict the tp of a given solution from a knowledge of electrode polarizations, conductivity, and current efficiency relationships, but these attempts have not met with total success, although Haring and Blum[1] and others were able to predict tp for some simple solutions using these considerations.

Most workers in the field, therefore, have taken the attitude that the thing to do was to devise a way of measuring a practical quantity which they would call the throwing power, which would not distinguish between these various factors but would lump them all together in one figure. The apparatus, in other words, would not measure the individual contributions of conductivity, cathode polarization, secondary or primary current distribution, and so forth, but would measure metal distribution directly and would lead to an arbitrary figure which would be called the tp of the solution.

The first attempt along these lines was that of Horsch and Fuwa in 1921.[2] They used a series of three cathodes at increasing distances from an anode perpendicular to all three. The cathodes were weighed before and after plating, and the weights of deposit taken as a measure of the tp of the solution. In a solution of good tp, the weights on the three cathodes were relatively uniform while in a solution of poor tp the nearest cathode received much more deposit than the farthest. A somewhat similar principle has been used in tp measurements ever since, but the method of Horsch and Fuwa was not well adapted to numerical expression of the results. They did, however, study many zinc plating solutions by this technique and got results which were at least qualitatively of definite value and interest.

What is probably the classic paper on measurement of tp was published two years later, in 1923, when Haring and Blum[1] invented their so-called tp box, which is still in wide use for measuring tp.

If the anode in the "Haring cell" is five times as close to one cathode as to the other, a solution with no tp will deposit five times as much plate on the near cathode as on the far. The ratio of the distances is designated as K, and the ratio of weights of deposit is designated as M. Then if M is less than K, tp will be positive; if equal to K, tp is zero; and if greater than K, tp is negative. Mathematically, Haring and Blum suggested that tp be expressed as a percentage, by the formula 100 x K/K-M.

This formula is still in use, but has been objected to by some, for several reasons: the value of tp depends

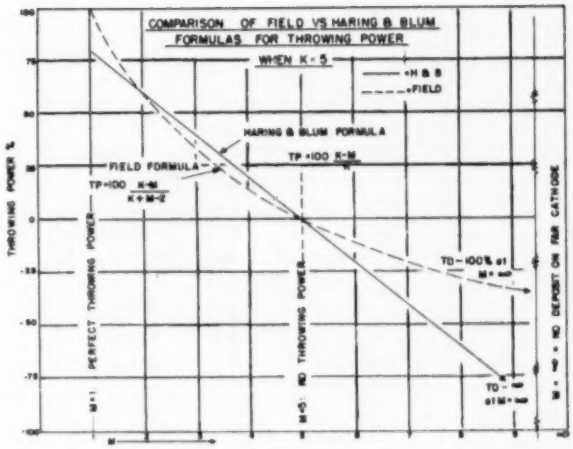
COMPARISON OF FIELD VS HARING & BLUM
FORMULAS FOR THROWING POWER
WHEN K = 5
H & B
FIELD
HARING & BLUM FORMULA
TP = 100 K-M
FIELD FORMULA
TP = 100 K-M / K+M-2
THROWING POWER %
PERFECT THROWING POWER
NO THROWING POWER
M = 1
M = 5
M
TD = 100% at M = ∞
TD = ∞ at M = ∞
M = ∞ = NO DEPOSIT ON FAR CATHODE

Fig. 1. Throwing power vs. metal ratio of K = 5 by the Haring-Blum and Field formulas

on the value of K which is chosen; that is, if K is 2 a different result will be obtained from that when K is 5. Further, for M = 1, which for all practical purposes is perfect tp, tp = 80 per cent when K is 5, 50 per cent when K = 2, and other values for other values of K. Intuitively one would like to have perfect tp expressed by a numerical value of 100 per cent regardless of the value of K. Finally, for no deposit on the far cathode, tp comes out minus infinity by this formula, and one dislikes—again intuitively—a plating variable which has to be expressed by infinity, either minus or plus.

Many attempts have been made to improve the Haring and Blum formula while still keeping the same method of measurement. The only one considered here is the formula suggested by Field:

$$tp = 100 \times K - M/K + M - 2.^{3}$$

This formula for tp has the advantages that (1) perfect tp, that is M = 1, is always 100 per cent, no

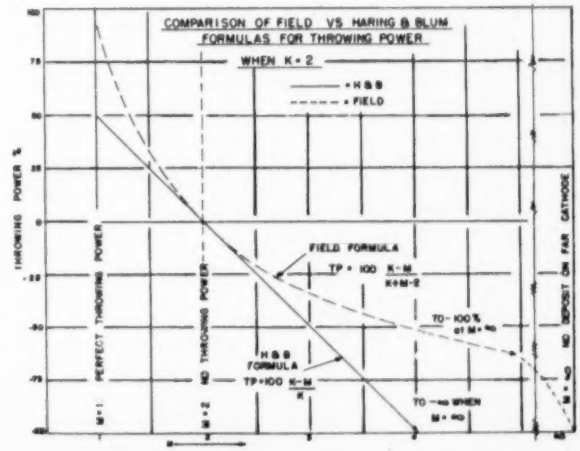
COMPARISON OF FIELD VS HARING & BLUM
FORMULAS FOR THROWING POWER
WHEN K = 2
H & B
FIELD
FIELD FORMULA
TP = 100 K-M / K+M-2
H & B FORMULA
TP = 100 K-M / K
THROWING POWER %
PERFECT THROWING POWER
NO THROWING POWER
M = 1
M = 2
M
TD = 100% at M = ∞
TD = ∞ WHEN M = ∞
M = ∞ = NO DEPOSIT ON FAR CATHODE

Fig. 2. Throwing power vs metal ratio at K = 2 by the Haring-Blum and Field formulas

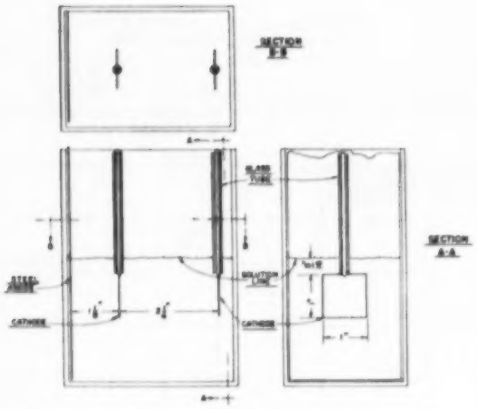

Fig. 3. Throwing power determination. Sternfels

matter what the value of K; (2) when K = M tp is still zero, as is should be; and (3) when M = infinity, that is no deposit on the far cathode, tp is minus 100 per cent instead of minus infinity. The relationship between the two functions is shown for K = 5 and K = 2 in Figs. 1 and 2. Notice that for small and moderate positive values for tp, the range of the great majority of plating solutions, the results by the two formulas do not differ very much.

Nevertheless, because of the definite advantages of Field's function for tp, it is the one adopted in the measurements here reported.

One might suppose that the problem of measuring tp had now been solved, with the Haring cell to make the measurements and the Field modification of the formula to express the results numerically. A great many measurements have been made through the years by a number of workers, resulting in a good general knowledge of the order of magnitude of the tp of various solutions; these were summarized by Schaefer and Pochapsky.[4]

In the meantime however it has been shown by several investigators that the whole method of the Haring cell is purely empirical and has no theoretical justification. Hoar and Agar,[5] among others, have shown that the current relationships depend not only on the geometry of the system but its absolute size. Changing the size of the Haring box while keeping the proportions constant produces a different result. The results also depend on what particular value is chosen for K, the ratio of the cathode distances. Thus the tp as measured in the Haring cell is not an inherent property of the solution but only a property of the solution in that particular cell. And since nobody does practical plating in a Haring cell, the results are of questionable practical value.

Let it be said that this does not mean that all the work which has been done to measure tp in Haring cells is worthless. It is certainly true that if a solution shows good tp in a Haring cell it will in all probability show good tp in practice and vice versa. What it does mean however is that the actual figures for tp

TABLE I. THROWING POWER OF TIN-PLATING BATHS
K = 3

Tin	Solution, oz/gal Free NaOH	or Free KOH	Cd asf	Temp. °F	Throwing Power % (A)	Na Soln.	K Soln.
5.6	1.1	1.5	18	122	56	42	80
			72		70	69	69
	(A + 2 oz/gal NaOAc)		18		35	44	66
			72	158	63	66	87
			18		58	69	62
			72	194	50	50	57
18.7	1.8	2.4	18	122		60	66
			72			69	76
			18	158		61	62
			72			55	44
			18	194		48	38
			72			35	51
7.9	5.7	7.9	18	122		62	52
			72			38	52
			18	158		61	67
			72			55	65
			18	194		74	75
			72			55	30

that we get in a Haring cell are of doubtful value, and that there appears to be little point in attempting the highest precision. The best we can do is to group solutions qualitatively as having tp in certain ranges, as Schaefer has done; and we can also investigate the effect of changes in composition, etc., on the tp in a qualitative way.

It should also be said that Haring and Blum realized the limitations of their method and frankly stated them in their paper; but some later workers seem to have forgotten this statement.

The Haring cell, however, is a fairly specialized piece of apparatus and demands rather critical control; and if the results are only roughly qualitative, it occurs to many investigators that it is hardly worth the trouble if simpler methods can be worked out. This has led to the development of tests like the bent cathode, and the cavity scale,[6] where solutions are tested as to how deep a hole they will just cover the bottom of. These, however, are really tests of covering power rather than tp; although the bent cathode can be made into a tp test if the amount of deposit on various sections is measured quantitatively instead of being merely observed by eye. These tests, also, do not give one a number which can be called the tp of the solution and are thus difficult to write up and report.

Sternfels[7] has devised a rough but simple test for tp the principle of which is shown in Fig. 3. Here a glass jar is used, with an anode at one side: two weighed cathodes are directly behind each other at distances from the anode in a ratio of 1 to 3; the far cathode is shielded by the near. Although there may be some objection to this, certainly such a condition obtains in practice. The cathodes are small compared to the total bath volume. By means of this apparatus, various measurements were made on both sodium and potassium stannate baths of various compositions; some of the results are shown in Table I. (Tp's are calculated by means of the Field expression.) The apparatus was calibrated by means of solutions of known properties:

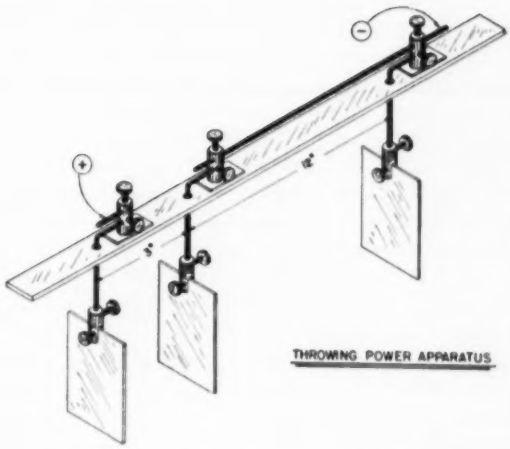

Fig. 4. Simplified throwing power apparatus

a chromium bath had a tp of −5 per cent, various cyanide coppers had tps of 40 to 65 per cent, and nickel solutions had tps of 14 to 30 per cent. Thus the results are of the right order of magnitude. It is evident that no clear pattern emerges from the results for stannate tin solutions; the best that can be said is that sodium and potassium baths have about the same tp.

Parenthetically, it might be supposed that with solutions of such excellent tp as stannate tin, the problem of tp would never come up; but just because the tp is so good, some platers expect the impossible. Thus it has been necessary to study the effects on tp of the variables involved in stannate tin solutions. These factors are complicated. One circumstance favorable to tp is a steep cathode efficiency–current density curve, and here one would expect sodium baths to be better than potassium. But high conductivity is also favorable to tp, and here the potassium bath is better. Temperature and bath concentration also enter in. So it is impossible to tell a priori

TABLE II. THROWING POWER OF VARIOUS SOLUTIONS

K = 5

Run No.	Solution	Temp °F	Cd Asf	Eff %	Ratio M	Throwing Power %
38	Tin-Nickel	150	10	98	2.34	50
32	Rochelle copper	122	10	69	1.98	60
33	Rochelle copper	122	20	75	1.87	64
34	Rochelle copper	150	10	79	1.71	70
35	Rochelle copper	150	20	66	2.01	60
39	Acid copper	92	20	87	4.29	10

TABLE III. THROWING POWER OF POTASSIUM STANNATE BATH

K = 5

Run No.	Solution: Tin oz/gal	Solution: Free KOH oz/gal	Temp ° F	CD asf	Efficiency Per cent	Ratio M	Throwing Power Per cent
19	5.0	0.65	158	10	84	4.70	4
18	5.0	0.65	158	20	74	3.52	23
17	5.0	0.65	158	40	53	2.21	54
21	5.0	0.65	176	10	84	5.17	−2
20	5.0	0.65	176	40	74	3.33	26
22	5.0	2.0	176	10	81	4.15	12
23	5.0	2.0	176	40	64	2.50	46
25	10.0	2.0	176	10	86	5.34	−4
24	10.0	2.0	176	40	84	3.00	33
26	10.0	2.0	176	80	75	2.61	43
	Sodium Stannate Bath						
	Tin	Free NaOH					
27	5.3	0.67	158	10	76	3.25	28
28	5.3	0.67	158	20	60	2.57	44
29	5.3	0.67	158	40	41	1.85	65
30	5.3	0.67	176	10	81	4.14	12
31	5.3	0.67	176	40	57	2.48	46

which factor will be most important, and testing becomes necessary.

Tests such as the covering of the inside of tubes, etc., have shown little difference between sodium and potassium baths; but as already stated, these are not measures of tp but rather of covering power.

In continuing the study of tp, it was decided to model our approach on that of Sternfels already described; but it was further desired to test the tp, if possible, right in the tank or in a large experimental tank, rather than in laboratory beaker set ups. After some trials a simple device was built which can be carried right to the plating tank for test, and which involves merely weighing of panels before and after plating, as shown in Fig. 4. The anode is a sheet of the appropriate metal, or it may be insoluble. The cathodes are at distance ratio or K of 5/1, and are connected as shown. The only precaution necessary is that the apparatus must not be used in small unlined steel tanks which can act as bipolar electrodes.

To show that the method is reasonably correct, it was first tried in some known solutions like cyanide-Rochelle copper and acid copper, with results shown in Table II. These results are of reasonable orders of magnitude and would seem to indicate that the setup is probably measuring tp reasonably correctly.

The tp of the new tin-nickel solution[8] is also shown in Table II. This is a very remarkable result, which incidentally is borne out by practical experience with this bath.

This remarkably high tp of the tin-nickel solution is extraordinary for several reasons: (1) This is a highly acid solution, and normally acid solutions do not have as good tp as alkaline ones. (2) The current efficiency is practically 100 per cent and does not vary much with current density, so that one would not expect high tp on this score. (3) Although polarization has not been directly measured in this solution, it must be very low because the overall tank voltage is only about one volt or less. The only favorable a priori factor is the very high conductivity of the bath. Further, the bath is very high in nickel content, but has a tp much higher than has ever been reported for a nickel solution.

No explanation is offered for this remarkably high tp of the tin-nickel solution; the fact, however, may be of considerable interest in possible applications of this new deposit.

The tp of some stannate tin solutions, as indicated by this technique, is shown in Table III. These results show clearly the effect of the various factors on the resultant tp: as we increase the temperature the tp tends to drop, because we are thereby decreasing polarization and lessening the slope of the efficiency-cd curve. As the alkali content is increased the tp improves for similar reasons in reverse. As the tin con-

tent increases, the tp tends to fall, because the efficiency curve is flatter.

As for the comparison between sodium and potassium baths at first glance it might seem as if the advantage is with the sodium, but on further examination it is evident that the high tp of the sodium bath is obtained only at the expense of a very low efficiency. For equal efficiencies, the tp of the potassium bath is as good or better; and for equal tp's, the efficiency of the potassium bath is better.

Compare, for example, run Nos. 27 vs 18, where efficiencies are equal, tps approximately equal, but the cd in the potassium bath is twice that in the sodium. Runs 23 vs 31 show equal tp and higher efficiency for the potassium bath; runs 20 vs 27 show equal efficiencies and tp but four times the cd in the potassium bath; runs 24 vs 30 show a potassium bath possessing higher tp than a sodium at approximately equal efficiency and at four times the cd, etc. Thus the tp is not so much a function of the (sodium vs potassium) cation as of the specific composition and operating conditions.

It should be emphasized that tp is only one property of a plating bath, and the user would be ill-advised to choose such conditions of plating, as low temperature, high alkali, and low tin, which seem to lead to best tp; because in so doing he is sacrificing efficiency, that is speed of plating; and if temperature is too low he may also tend to get grayish instead of satin tin deposits. Usually, the tp of the stannate bath—both sodium and potassium—is good enough for all practical purposes. However, if you have a really critical throwing problem, it may pay you to investigate ways of improving the tp along the lines indicated by these data; that is, to operate in a relatively steep portion of the cd-efficiency curve. This steep portion of the curve falls at different regions along the cd axis depending on the composition, operating conditions, and cation (Na or K) of the bath. These factors have been discussed elsewhere by the present author and others.[9]

The tp of the tin-zinc alloy plating bath has been investigated by Cuthbertson and Angles.[10] In alloy plating, another factor enters the picture also: not only how well the deposit is distributed, but also whether it is of uniform composition throughout. Data have been published indicating both the excellent tp of the tin-zinc plating bath and the excellent constancy of deposit composition; this might be called "Composition tp." A modification of the bent cathode test was used in which the cathode was cut up into strips after plating and each strip individually measured both for thickness of plate and for composition of alloy coating.

This work on tin-zinc represents a valid use of the bent cathode to measure true tp rather than covering power, but it still has the disadvantage that the results are not expressible by a number, as they are from Haring cell and similar measurements.

It has been the modest aim of this paper to review some of the high spots of this rather important property of tp; to indicate what may be a valid and easy way to measure it, and to show some preliminary results on the factors affecting tp in stannate tin plating; as well as to point out specifically the surprisingly high tp of the newly developed tin-nickel process, and the excellent properties of tin-zinc alloy in this respect.

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DISCUSSION

MR. MARVIN RUBINSTEIN (Consultant, Bronx, N. Y.): Have you had any results at all so far on throwing power of tin-cadmium solutions?

DR. LOWENHEIM: I will answer that very quickly—no, we have not gotten that far. It should be very good.

MR. NORMAN ALBERT TOPE (Montgomery Plating Company, Ltd., Coventry, England): I was rather surprised in Dr. Lowenheim's paper not to notice any reference to the acid tin solution. In England we use that quite a good deal and we find that it has exceptionally fine throwing power for an acid solution. Dr. Gardam brought that fact to light in a paper he presented to this Society some years ago and most people don't use it where they might use it to great advantage.

DR. LOWENHEIM: The work we have done on the acid baths has been of an extremely preliminary and cursory nature because we are not terribly interested in them commercially. I agree with you that for an acid solution it has remarkably high throwing power which seems to have something to do with tin; tin seems to have good throwing power. I don't know, when you speak of acid solution, whether you are speaking of the acid sulfate, fluoborate or some other.

MR. TOPE: I am thinking of sulfate with addition agent.

SERVO CONTROL IN THE ELECTROPOLISHING OF WIRE AND STRIP*

BY A. KORBELAK† AND C. M. BIVELY‡

ABSTRACT

From the polishing wheel to the plating line, from the drying units to the packing department, metal finishers today are concerned with the application of automatic controls to their machines, equipment, processes and plants.

In the following paper the authors describe a novel development in the field of automation. The continuous control in the electropolishing of fine wire was solved successfully by the use of a principle which, in general, is the same as that used in the recording of the human voice or music on magnetic tape to be stored away and played back later.

With this method the authors were able to win their objective of an improvement in a product's standard of quality, a standard previously not attainable by any means.

INTRODUCTION

The continuous production of fine wire and strip with a perfectly uniform cross section always has been the goal of the wire industry. It is especially the concern of the producers of electric lamps[1] since any necked down or nonuniform portions of the heart of such a lamp, the tungsten wire filament, operates hotter and thus vaporizes faster than adjacent heavier sections of the wire. These hot spots directly affect the service life of tungsten filament lamps. A uniform wire is also the concern of the booming electronic industry. Here, in the new miniaturization developments, tighter standards have been imposed on the producers of fine wire. As these standards were narrowed the costs of making the product to meet the newer requirements were found to be high enough to warrant serious study into the perfection of less costly methods.

Three of the more common methods of reducing the size of fine wire are (1) drawing through a series of diamond dies, such dies being expensive and requiring skilled craftsmen for their preparation and maintenance; (2) chemical dissolution and; (3) electropolishing.

Drawn Wire

A number of factors affect the uniformity of drawn wire. Among these are: varying die temperatures during drawing operations, nonuniform hardness of the wire being drawn, die wear and die imperfections which result in irregularities in the finished wire. Control of these factors is a separate problem beyond the scope of this paper and will not be discussed by the authors.

Chemical Dissolution

The reduction of wire sizes by dissolution in mixtures of chemicals is used in industry today. It is often unsatisfactory because of unpredictable and uncontrollable etching of the metal being treated. For example, a mixture of molten sodium nitrate and sodium nitrite is used to reduce 0.0005 inch tungsten wire to a diameter of 0.0002 inch. The method is slow, hazardous and expensive.

Electropolishing

Electropolishing is a destructive method in that base metal is dissolved. The method thus can not be used economically to replace drawing except in the very fine wire sizes. It may have some utility as a method to strip unwanted superficial and harmful surface layers, or as a method to reclaim larger sizes to prevent irregular wire from damaging expensive dies to be used in the next reduction step. Electropolished die-drawn wire has some of the wider variations that were present before the polishing operation but the electropolishing operation does scale these downward to result in acceptance instead of rejection of the product.

Continuous electropolishing of fine wire is not new.[2] However, a system for electronically controlling the polishing current as wire variations occur is a new approach to the manufacture of high quality wire.

EXPERIMENTAL WORK

Initially a series of experiments were conducted to determine the amount of levelling that could be produced by the action of various electrolytes on tungsten. The solution that proved to be the best was trisodium phosphate maintained at a concentration of 160 g/l

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*Presented at the Forty-First Annual Convention of the American Electroplaters' Society, July 13, 1954.

†Sales Manager, Sel-Rex Precious Metals, Inc., Belleville, N. J.
‡Electrical Equipment Design Engineer, Westinghouse Electric Corporation, Bloomfield, N. J.

Fig. 1. Surface roughness comparison of tungsten wire before (top) and after (bottom) electropolishing. Reproduced from a tracing from a Brush Surface Analyzer. Original tungsten surface roughness = rms range of 15–30; rms average of 22 microinches. Electropolished surface = rms range of 1–3; rms average of 2 microinches

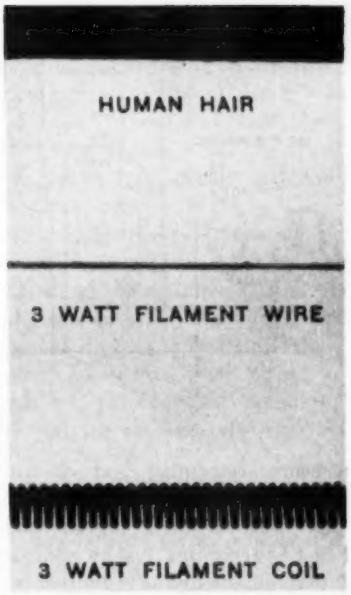

Fig. 2. Comparison of typical end product of electropolished tungsten wire (center) with human hair (top) and incandescent lamp filament (bottom)

(21.4 oz/gal) to ± 10 per cent. The best operating temperature was established at 110° F ± 5° F. At a current density of 2.5 amperes per square inch (360 asf) an original surface roughness of 30 microinches, rms (average), was electropolished to one showing a value of 2 microinches, rms (average). Heating of the bath to over 130° F resulted in rougher and pitted surfaces. Fig. 1 illustrates a surface roughness comparison of tungsten wire before and after electropolishing. Fig. 2 is from a photo that shows a comparison sample of some of the end product produced by the method.

Fig. 3 shows a layout of the processing line used for fine wire. A spool of wire first was cleaned free of oxides and drawing lubricants by passage through a boiling solution of 25 per cent tetrasodium ethylenediamine tetraacetate. The cleaned wire, 0.0005 inch in diameter, then was mounted in the processing line as shown. The wire next was passed through two elevated cells positioned over a storage tank where a pumping arrangement forced electrolyte into the elevated cells where the solution then fell back to the original storage tank. A total current of 250 milliamperes on a 9-inch section of wire was used at a wire speed of 656 feet (200 meters) per hour. A resistance measuring step described in detail later in this text along with an accompanying electronic circuit was inserted ahead of a follow-up treatment tank where final corrective electropolishing current was used to produce a wire with a diameter of 0.0002 inch. A clean running water rinse in a bubbler-overflow arrangement was used to rinse the wire free of electrolyte. Infrared drying lamps completed the operation just ahead of the respooling unit. Several thousand meters of wire were processed successfully by a unit similar to the one described. Modifications, of course, could be made to provide for multiple strand processing for increased productivity. Also a multiple tray-tank arrangement could be used to secure faster output or provide for a greater reduction of the initial wire size.

Discussion

The system discussed previously, with some minor revisions can be adapted to the electropolishing of wire other than tungsten and to the electropolishing of narrow strip material where high quality is required of the final product.

This paper describes the laboratory unit that was built to investigate the feasability of more precise control of wire electroreduction. It was decided arbitrarily that the unit should meet the following conditions:

(1) The wire should be electropolished at a rate of 200 meters per hour or more (11 ft/min)
(2) Wire with diameters from 0.0005 inch to 0.005 inch should be handled by the same equipment
(3) Short length variations as well as changes in diameter from one end of a spool of wire to the other should be corrected with the same degree of accuracy.

Some of the problems, including those of making contact to the wire and those of keeping the wire temperature at uniform values during the resistance measurement, were solved with but little difficulty. However, the real problem turned out to be in the phase of the unit involved with the making of the wire resistance measurement at a position remote from the electropolishing position. A system had to be devised to

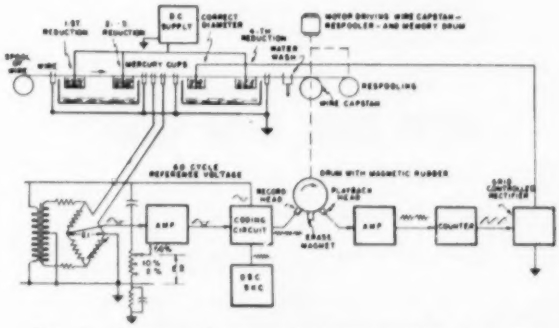

Fig. 3. Layout of processing line used for fine wire electropolishing

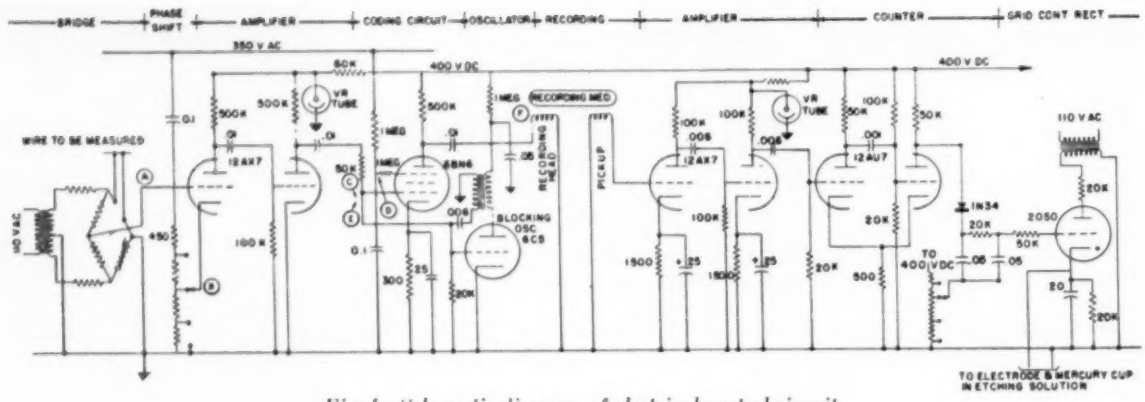

Fig. 4. Schematic diagram of electrical control circuit

measure, remember and electroreduce continuously. Memory systems which remember 0, 1 or "yes" and "no" are common in digital computers of today. An FM-FM recording system used for recording pertinent data in missile flights is another possibility as a memory system which would meet the requirements of the wire problem. Both of these suggested systems require large and expensive equipment, and thus were not considered seriously.

Pulse-time[2] systems were tried, but could not be applied because the disc carrying the recording medium had to be driven from the capstan pulling the wire. The peripheral speed of the capstan (and therefore the recording disc's speed) was found to vary as much as 20 per cent in 1/60 second. Since the spacing between recorded pulses represents the resistance measure, variations in speed appear to be variations in resistance that are nonexistent and false.

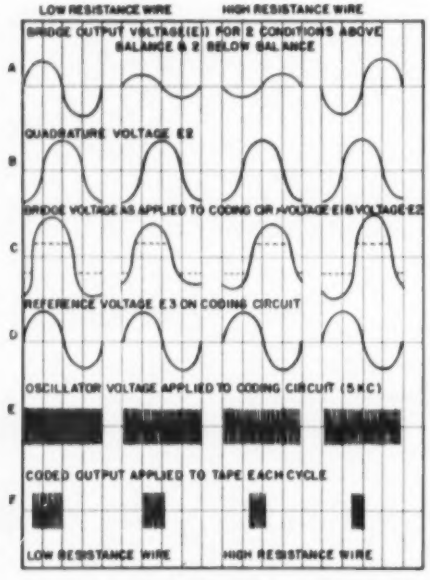

Fig. 5. Illustration of wave forms at the alphabetized points in Fig. 4

Either a constant speed drive for the capstan or an electronic scheme to bypass the speed variation had to be developed. The latter course was chosen to make the unit adaptable to any machine.

Electrical Control Circuit

The electrical control circuit shown in Figs. 3 and 4 is basically a delayed feed back system. It consists of three fundamental parts:

(1) A bridge to measure the incremental resistance of the wire as it progresses through the tanks;

(2) A recording system which remembers the measured resistance while the wire passes from the bridge to the polishing position; and

(3) A means to convert the memory signal to polishing current so that the wire diameter will be reduced a greater or lesser amount in response to the lower or higher measured resistance.

Bridge Circuit

Two Lucite cups containing mercury are located between the tanks and in line with the wire to effect electrical contact for the resistance measurement. For wire other than tungsten special conducting liquids may be used.* The cups are designed to permit the wire to remain as deeply as possible in the conducting medium, thus minimizing the effect of surface turbulence. The spacing between cups is adjustable so that wire increments of over 200 millimeters down to 4 millimeters in length can be measured. Shorter lengths are preferred but result in difficulties that will be discussed later.

The bridge circuit in the block diagram of Fig. 3 has two fixed resistive legs, a third leg composed of the mercury cups and wire to be measured and a fourth leg in which a 10-turn potentiometer is set to the center value of resistance for the wire to be processed. The bridge circuit, connected to an alternating current source, has an output voltage which is zero at balance, and varies in magnitude for conditions of unbalance. In addition, the voltage due to unbalance on one side of center is 180° out of phase with the voltage due to unbalance on the other side.

In Fig. 5 the relationship is shown at a. A quadra-

*Similar systems with other wire have employed masses of wool and like materials well soaked with electrolytes such as dilute acid.

ture voltage, b, is added to the bridge output resulting in the voltage shown at c, which varies in both phase and amplitude. Only the phase variable is used, the amplitude being clipped in succeeding amplifiers.

Recording System

The coding circuit of Fig. 3 has 3 inputs: (1) a reference 60 cycle voltage; (2) the 60 cycle voltage from the bridge; and (3) the output of an oscillator operating at 5 kilocycles. Since the tube in this circuit is a gated beam type (6BN6), it has in its output the full amplitude of the 5 kilocycles signal when both the reference and bridge voltages are positive, and zero output if either is negative. In Fig. 5, c, d, and e show the reference, bridge and oscillator relationship. In the same figure, f shows the resulting waveform composed of pulse groups with a 60 cycle repetition rate. The number of pulses per group varies as the resistance, being greater in number for a lower resistance.

The recording medium is a commercial unit mounted on a five inch diameter disc.* The disc is on the same shaft that drives the capstan that pulls the wire through the solution. Recording and reproduce heads are spaced at a distance around the circumference of the disc equal to the distance the resistance measuring station is to the follow-up electropolishing position. A permanent magnet eraser removes the pulse groups by saturating the magnetic medium in the opposite direction. The tape thus is ready for a new signal from another section of wire being processed.

Converting System

The signal from the magnetic memory is amplified so that the leading edge of each pulse in a train will trigger the one shot multivibrator that is used as a counter. Once triggered, the multivibrator remains conducting for a fixed period of time and then falls back to its stable state, awaiting the next pulse. Since the conduction period is constant in duration, the condenser in the plate circuit of this counter will charge an equal amount for each pulse in a train. In this manner, the peak voltage on the condenser is directly proportional to the number of pulses in each group. Reasonable variations in the peripheral speed of the recording disc have no effect on the decoded results because the same number of pulses are present whether they are grouped closely or spread out.

The peak voltage on the condenser is applied to a grid-controlled rectifier which regulates the direct current voltage needed for the polishing of the wire.

Limitations of the System

Although the unit described does produce a fine wire of desired uniformity, the circuit has some limitations.

The phase shift system used with the bridge is linear for only ± 30°. But a phase system still is preferred because variables such as tube aging, line voltage changes and other conditions common in electronic equipment have little or no effect on the circuit performance.

As can be seen from Fig. 5, the full 60° phase shift is divided into 13 pulses so that the minimum step is 7.5 per cent of the range selected. The use of higher frequencies requires higher tape speeds which in turn require a much larger wheel or tape storage arrangement.

Production models of the laboratory equipment described above will be modified to overcome the limitations. By the arrangement of three channels each to record every third cycle of a 15 kilocycles signal, the accuracy can be improved to 3 per cent with no change in tape speed. A value of E2 in Fig. 3 will be set to handle wire which varies ± 5 per cent (the maximum found by the authors) and the finished wire will be accurate to 0.3 per cent.

The increment of wire in the resistance measuring section should be as short as possible, otherwise the entire measured length will be reduced to compensate for a shorter length of oversize wire. Two limitations which prevent measuring very short lengths are the varying meniscus of mercury around a moving wire and (2) the shape of the electropolishing, (cathode) its position and the current density. Although they present a problem at this time, these too, appear ready for a simple solution.

Summary

The electropolishing system described, though specifically directed toward the production of fine tungsten wire, may be adapted to other metals, with modifications being required in electrolyte and electrical contacting media.

The principles of the system may be applied, without too great a stretch of the imagination, to full and semi-automatic cycles to correct for missing racks, or partially filled ones in electroplating lines and thus make for a truly "push-button" operation.

Acknowledgment

The system outlined above is covered by the authors' patent applications, assigned to the Westinghouse Electric Corporation, now on file at the United States and Canadian Patent offices. The authors take this means to express their appreciation to the Patent Department of that company for the permission to publish the manuscript at this time. Also, an expression of appreciation is extended to D. A. Bogdan and L. C. Werner for their many helpful suggestions in connection with the project.

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*Brush model BK603 rcecording rubber manufactured by the Brush Development Co., Cleveland, Ohio.

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Book Review

DR. HAROLD J. READ

Professor of Metallurgy,
The Pennsylvania State University

FERROUS PROCESS METALLURGY by John L. Bray, 1954, ix + 414 pages. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. Price, $6.50.

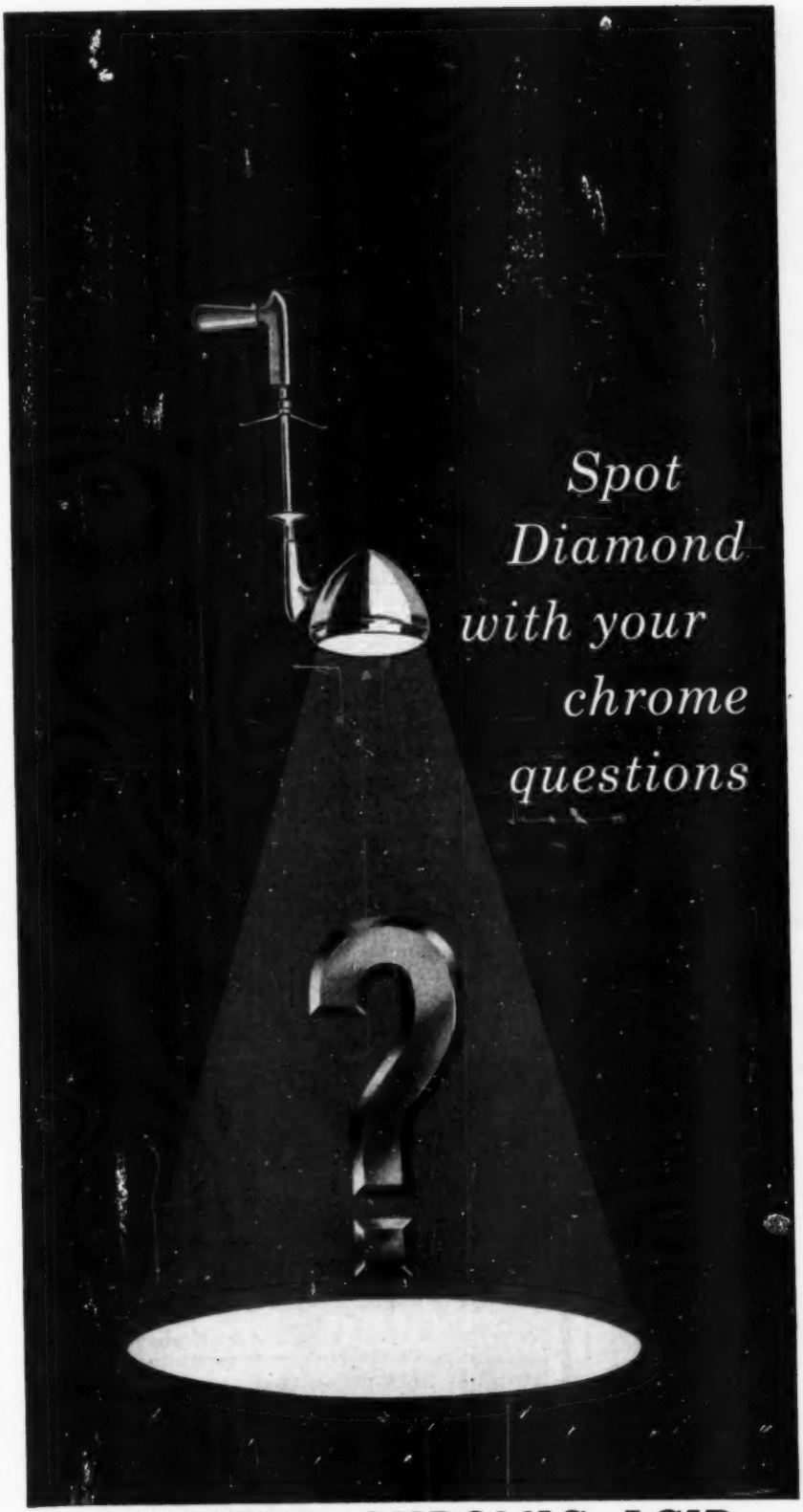
From time to time we have used this space to review books covering subject matter which is only indirectly associated with metal finishing. Although there is no compelling reason why a metal finisher should be familar with the processes of iron and steel making, a knowledge of this field will certainly be a significant contribution in building the general background which will broaden his approach to the study and solution of his own immediate problems. The late Professor Bray has treated with force and clarity not only the traditional process of ferrous extractive metallurgy, but he has also interlarded his text with descriptions of innovations which are of current interest and importance.

Those trained in the field of chemistry will appreciate particularly the physical-chemical approach. This is most unusual in metallurgical treatments of ferrous process metallurgy. Most of the available texts consist of little more than long, often-boring descriptions of equipment and operational procedures. Seldom do authors inquire into the basic chemistry of the reactions which take place in the various furnaces and other items of equipment. The chemistry of high-temperature processes is fascinating and it is a field in which there is considerable important current activity. The extent to which Professor Bray incorporated recent basic information into his text without slighting traditional processes is most remarkable.

The flow of raw materials through the blast furnace and through the various steel-making processes is traced in appropriate order in the various chapters of the book. The number of pages devoted to the Bessemer converter, the basic open hearth, the acid open hearth and the electric furnace appears to be proportionate to the importance of the process. The text closes with the freezing of finished steel, and there are no discussions of rolling, forging, drawing or other fabrication processes. These fall in the field of physical rather than process metallurgy.

Those who are not at all familiar with ferrous production metallurgy will appreciate the many line drawings which clearly reveal the essential details of items of equipment. These drawings are in sharp contrast with the complicated working drawings or unrevealing photographs which are commonly used in text books.

Perhaps the only outstanding weakness of the text is the lack of references to the literature or suggestions for additional reading.



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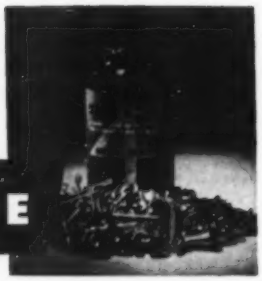

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Electrochemical Method for Determination of Adhesion of Electroplating. A. T. Vagramyan and Yu. S. Tsareva, Doklady Akadamii Nauk SSSR, 74, No. 2, 303, 1950.

Usefulness of nondestructive method for testing electrolytic deposits for adhesion to basis metal, and importance of current cleaning of the latter preparatory to plating. Principle underlying the proposed method. Relation between active surface cathode (to which deposition is confined) and numerical value of polarization in the instant the current is turned on. Experiments on deposition of copper on a copper cathode cleaned for plating in three different ways. Results obtained with proposed electrochemical method checked against results of bend test. Difficulties obstructing the recording of precise polarization curves. Calculation of active electrode surface for different preparatory treatments of basis metal.

Henry Brutcher, Box 157, Altadena, California.

Descaling by Reduction of Scale with Sodium Hydride. A. V. Smirnov et al, Vestnik Mashinostroeniya, 33, No. 3,37, 1953.

Merits of reduction of scale with the use of sodium hydride vs. acid pickling or dipping. Thermodynamic calculations underlying this process. Experiments conducted by authors. Setup used (Fig. 1). Procedure, effectiveness of scale removal determined by weighing the specimens before and after the treatment, and compared with results obtained with three other descaling processes. Economics of process; its special advantages for the descaling of high alloy steels.

Henry Brutcher, Box 157, Altadena, California.

Dissolution of Steel in Sulfuric Acid Under the Influence of Ultrasound. A. P. Kapustin and M. A. Fomina, Doklady Akademii Nauk SSSR, 83, No. 6, 847, 1952.

Lack of data on the effect of ultrasound upon fusion (dissolution) processes. Author's study of influence of rapid mechanical vibrations on dissolution rates of various substances, particularly of steel. Results of preliminary experiments. Main experiments concern exposure of steel plates immersed in 1 N sulfuric acid to ultrasound and effect of exposure on rate of dissolution. Relationship between ultrasound intensity and amount of steel dissolved.

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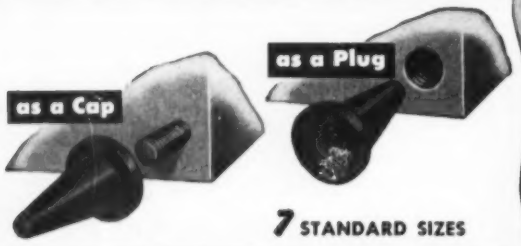

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Article Abstracts

Regeneration of Electropolishing Solutions for Steel. N. P. Fedot'ev, E. G. Kruglova, and S. Ya. Grilikhes. Zhurnal Prikladnoi Khimii, **27,** No. 2, 157, 1954.

Investigation into causes of deterioration of electrolytic polishing baths having an approximate composition of 64 per cent H_3PO_4, 14 per cent H_2SO_4, and 6 per cent CrO_3, and development of methods for adjusting and regenerating such baths; more specifically for maintaining their composition constant, chiefly by oxidizing the trivalent chromium, within definite limits until the permissible iron content is exceeded, and then for removing the iron from the electropolishing bath. Study of causes of inactivation; process of oxidation of trivalent chromium; effect of material selected for anode, and of composition of bath on oxidation of trivalent chromium; how to insure a quantitative oxidation of Cr_2O_3; suggested optimum conditions for it. Regeneration of spent baths: reduction of sexivalent chromium; reduction of ferric iron and precipitation of $FeSO_4$; effect of cathode current density. Proposed most favorable conditions for regeneration of electropolishing baths for steel.

Henry Brutcher, Box 157, Altadena, California.

Chromium Plating of Cutting Tools. E. I. Feldshtein et al, Stanki I Instrument, **18,** No. 4, 24, 1947.

Basic chromium plating practice used in study; three variants of basic practice (different current densities, plating times, and bath temperatures); as tested on basis of cutting tests run on chromium-plated tools. Tool types covered by study. Results of tests . . . Advantages of electropolishing over mechanical grinding and polishing for surface preparation. Data on best electropolishing bath composition and practice for different steels. Improvement in endurance of various tools.

Henry Brutcher, Box 157, Altadena, California.

Metal Quality Control by Anodizing. A. V. Sh eider, Zavodskaya Laboratoriya, **16,** No. 3, 375, 1950.

Application of anodizing chromic acid to aluminum alloys for detecting defects. Advantages of chromic acid over oxalic and sulfuric acids with respect to film formation and surface quality (Table I). Particulars on an electropolishing practice insuring very distinct development of macrostructure.

Henry Brutcher, Box 157, Altadena, California.

Nondestructive Ultrasonic Testing by the Pulse-Echo Technique. A. Lutsch, Archiv Eisenhuttenwesen, **23,** No. 1-2, 57, 1952.

Advantages of the pulse-echo technique using longitudinal and shear waves. . . . Testing of sheets and plates, e g. for laminations; testing of enamel coatings, electrodeposits, and lead-clad steel plate.

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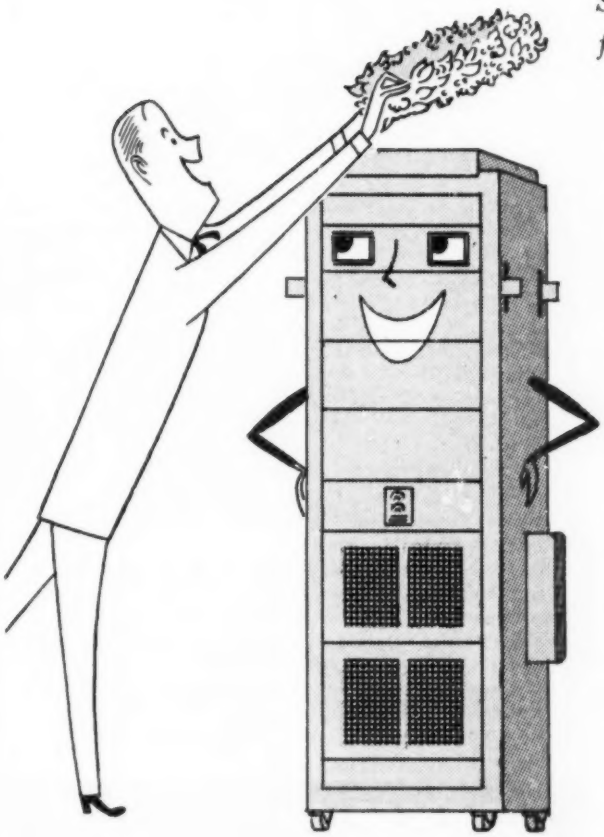

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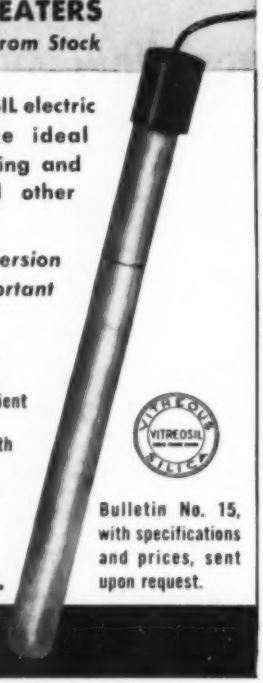

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Article Abstracts

Electropolishing with Unidirectional Current. J. Steiner. Metalloberfläche **B6**, 65 (May, 1954). Light Metals Bull. **16**, 510 (June 18, 1954).

Several circuits were used to produce unidirectional current having different wave shapes and the effect upon these wave shapes of polarization and passivation was studied. Using a simple subjective method of estimating brightness by observing the reflection of a grid pattern, the effect of the different current wave shapes on the brightness of electrolytically polished metals (including aluminum in different baths) was investigated. Both slight beneficial and detrimental effects were noted.

An Introduction to the Electrodeposition of Aluminum. A. W. Castle. Electroplating **7**, 291 (Aug. 1954).

The potential usefulness of aluminum as a coating metal both for decorative and protective applications has yet to be explored by the electroplater. Alternative methods of applying the metal by spraying, vacuum deposition, hot dipping, or cladding are of rapidly increasing importance; yet, for most types of work, could not compete either in cost or in deposit properties with a production electroplating process. The author reviews some of the difficulties involved in electrodepositing the metal and the many attempts that have been made to overcome them, including recent processes developed in the U. S. A.

Measuring the Thickness of Nonmagnetic Layers on Nonmagnetic Basis Materials with Beta Rays and Counting Tube. R. Berthold. Stahl Und Eisen, **73**, 945, 1952.

Use of Geiger counter for measuring X-rays excited by beta rays in determining thickness of nonferromagnetic substratas such as Cr, Zn, or Pb on aluminum, or Ag or Au on brass. Principle of measuring setup (Fig. 1). Relative energy and hardness of X-rays produced by beta radiation of Tl 204 in relation to atomic number of target element. Examples of results obtained; accuracy ± 1 micron with a layer thickness of 10 microns (Cr on Al).

Henry Brutcher, Box 157, Altadena, California.

Chemical Polishing of Iron on Soft Steel. L. Beaujard, Comptes Rendus, **234**, 440, 1952.

Brief report on a solution suitable for the chemical polishing of pure iron and steels with less than 0.05 per cent C which gives results on a par with electropolishing. Composition of agent. Extent of temperature range within which the proposed solution may be used. Nature of brown surface film obtained on specimens treated. Addition agents slowing down the etching attack without impairing the quality of the polish.

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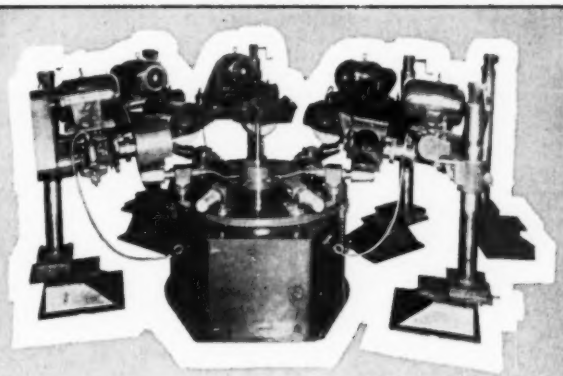

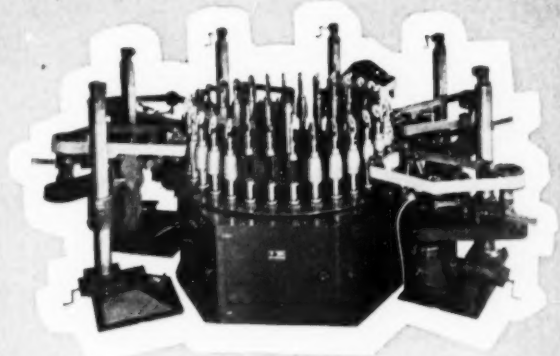

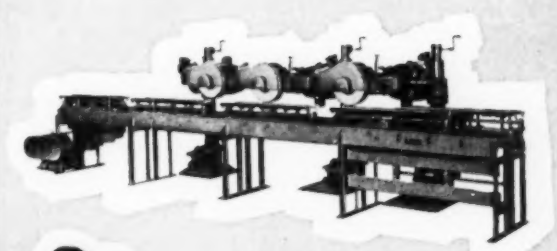

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Patent Abstracts

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Manager, Electrochemical Development
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No. 2,684,892—Ferric Chloride Etching Solutions—T. A. Saulnier, assignor to Radio Corporation of America, July 27, 1954.

An etching solution used for nickel, copper, and copper-nickel alloys, consisting of a water solution of ferric chloride with a specific gravity of 35°–45° Bé, 20–50 g/l of ammonium or alkali metal persulfate, and 2–10 per cent by volume of concentrated hydrochloric acid or nitric acid or a mixture of the two acids. The etching is done below 130° F.

8 claims.

No. 2,684,937—Brass Plating—L. R. Westbrook and E. J. Hoehl, assignors to Pittsburgh Steel Company, July 27, 1954.

A yellow brass plating solution is described wherein the sodium hydroxide content is over 3 oz/gal and the zinc content is low so that the copper-zinc ratio lies between 35:1 to 10:1. Claim 3 describes the bath as sodium cyanide, 9–22 oz/gal; copper cyanide, 3–16 oz/gal; sodium hydroxide, 3–16 oz/gal; and zinc oxide, 0.2–1.4 oz/gal. The operating temperature is given as 150–200° F, the current density at 25–150 asf.

24 claims, 5 figures.

No. 2,684,939—Apparatus for Plating Chromium—C. F. Geese, assignor to Time, Inc., July 27, 1954.

A spot plating apparatus is described consisting of a rigid nonconductive tip attached to a hollow reservoir for plating solution and carrying an anode inside the opening of the tip (not unlike a retractable ball-point pen).

3 claims, 4 figures.

No. 2,685,536—Method for Electrostatically Coating Articles—W. A. Starkey and E. M. Ransburg, assignors to Ransburg Electro-Coating Corporation, Aug. 3, 1954.

A method is claimed for electrostatically depositing liquid as a coating on an article through a head supplied by force feeding a liquid thereby releasing discrete particles into an electrostatic field of sufficient strength to move the particles to the article.

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The disclosure claims advantages over spray gun electrostatic field application of such coatings.

11 claims, 9 figures, and a total of 19 references cited.

No. 2,685,545—Production of Carbide Surfaced Wear-Resistant Ferrous Bodies—Seymour J. Sineband, assignor to Wearex Corporation, Aug. 3, 1954.

A method for making a wear resistant surface by forming metal carbides on the surface is claimed. The method includes mechanically working the ferrous surface which should contain at least 0.4 per cent carbon, removing the work-affected stratum (0.020 inch), and depositing on the exposed surface region at least one metal selected from the group consisting of titanium, columbium, tantalum, molybdenum, and tungsten from a compound of the metal at high temperature to form a metal carbide layer of the deposited metal.

4 claims.

Chromium carbide wear resistant surface formation is covered in **2,685,543** to same patentee.

4 claims.

The production of vanadium carbide surfaced wear-resistant bodies described in **2,685,544.**

2 claims.

No. 2,685,563—Anodic Oxidation of Aluminum—G. G. Gauthier, assignor to Pechiney Compagnie de Produits Chimiques et Electrometallurgiques, Aug. 3, 1954.

A method is claimed for providing a very flexible, insulating oxide coating on articles formed of aluminum and alloys of aluminum containing at least 90 per cent aluminum by anodizing in a bath consisting of 3–70 per cent by weight of sulfuric acid and at least 1 compound selected from the group consisting of alkali metal chlorides, bromides, and iodides (or halogen acids) to provide 0.1–20 per cent by weight of halogen in the bath. The temperature given is 15°–25° C. An alternating current density of 14–250 r.m.s. amperes per square decimeter and a direct current density of 5–70 amperes per square decimeter and a voltage of 10–25 volts is covered in claim 6.

6 claims.

No. 2,685,564—Electrolytic Cleaning Process—R. A. Emmett, Jr., and W. A. Petering, assignors to Detrex Corporation, Aug. 3, 1954.

It is claimed that the removal of smut-like materials from metal articles may be accomplished by immersing the article as one electrode in an aqueous solution which may contain polyphosphates, monophosphates, citrates, acetic acid-acetate mixtures, bicarbonates and dichromates at a pH of 3.5 to 10 and a temperature of 140–160° F and passing an assymetric reversing electric current through the article and the solution. The total positive electricity should exceed the total quantity of negative electricity and the ratio of the time of application of + to − current being in the range of 2:1 to 8:1. Electrical

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conditions disclosed include 3 volts or more and better than 30 asf as well as the time of 4 seconds anodic to 1 second cathodic.

19 claims.

No. 2,686,135—Hot Dip Plating Method and Apparatus—J. E. Butler, assignor to National Steel Corporation, Aug. 10, 1954.

A method is claimed for reducing the usual thicker metal (tin) coating on the trailing edge of sheets subjected to hot dipping processes by vibrating said trailing edge in the liquid cover (e.g., palm oil for tin) for the molten metal, a vibrating rod provides the necessary vibration by being positioned well below the catcher rolls and a magnet situated nearby assists in making contact with the rod.

15 claims, 6 figures.

No. 2,686,355—Process for Coating Metals with Aluminum—Harald Lundin, North Bergen, N. J., August 17, 1954.

A method for coating cobalt, chromium, nickel, iron and their alloys with aluminum is claimed whereby the article is cleaned, then treated by a flux wash consisting of complex alkali metal fluorides of zirconium or titanium after which the article is coated with aluminum by contact with molten aluminum.

16 claims.

A related patent No. 2,686,354 granted Mr. Lundin describes a process for coating and uniting shapes with aluminum by abutting the articles, fluxing with the complex titanium or zirconium fluoride (e.g. potassium zirconium fluoride) then hot dipping in aluminum.

6 claims.

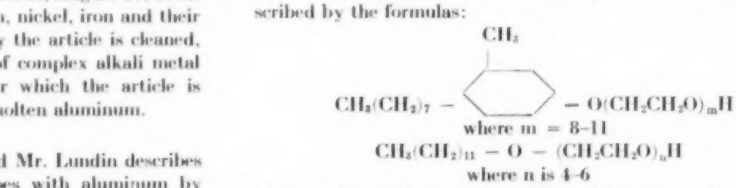
No. 2,686,756—Chromium Plating—J. Stareck and R. Dow, assignors to United Chromium, Inc. New York, August 17, 1954.

The discussion reveals the process as applicable to metals subject to corrosion such as steel, and the plate can be buffed to a bright appearance where desired. The claims cover plating at 0.5 to 8 asi at 140° F to boiling in a 200–900 g/l chromic acid bath with strontium sulfate and an alkali metal silicofluoride present to regulate the catalyst content closely. The alkali metal silicofluoride concentration limits are given as 1.0–11.4 g/l (as $SiF_6^{=}$) and the sum of said dissolved sulfate and silicofluoride being 1.5–11.7 g/l and varying with the CrO_3 concentration as shown by curve.

7 claims, 1 figure.

No. 2,686,757—Suppression of Honeycombing in Cathode Nickel—W. J. Cook, W. V. Barker and J. H. Tuck, assignors to The International Nickel Company, August 17, 1954.

A process is claimed for electrorefining nickel from a bath containing 40–70 g/l of nickel, 12–30 g/l of sodium, 18–55 g/l of chloride, 65–115 g/l of sulfate, 15–25 g/l boric acid and 0.0003–0.001 g/l of at least one compound of the groups described by the formulas:



The conditions given are: 3–5 *p*H, 100–160° F, and 5–25 asf.

16 claims, 2 figures.

No. 2,686,859—Electroplating—A. N. Gray and G. E. Murray, assignors to Western Electric Co., August 17, 1954.

A method for improving the conductivity of steel wire by plating with highly conductive copper is claimed. This is accomplished by alternately plating and deplating by passing the wire through a series of tanks. The amount of copper removed is 5–10 per cent of the previously deposited copper.

THE NEW DANIELS 8H

Daniels presents the radically new 8H Plating Barrel with these innovations:

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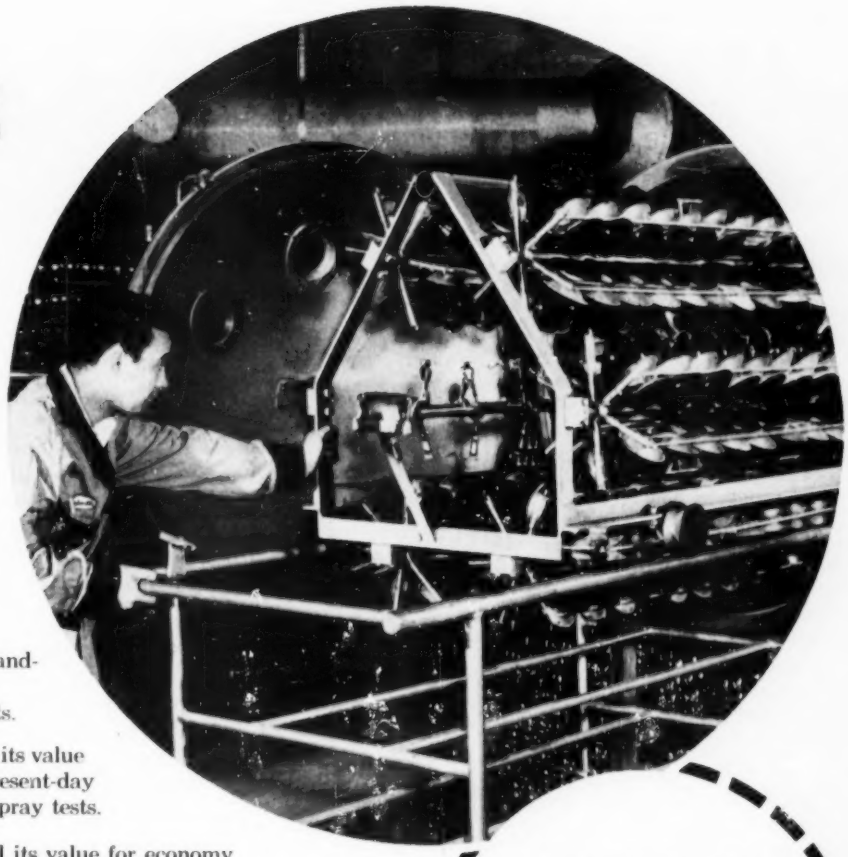

Packard parking lamp reflectors—720 to a load—enter the Stokes Vacuum Metallizing chamber at Detroit Plastics Molding Co., a leading metal finisher and plater. In a matter of minutes these reflectors will be brilliantly metallized.

Leading metal finishers are expanding their markets by vacuum metallizing many metal products.

Vacuum metallizing has proved its value for wear. The finish outwears present-day chrome plating 10 to 1 in salt-spray tests.

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Vacuum metallizing has proved its versatility. Colors can be applied throughout the spectrum from a silvery aluminum to brilliant, transparent undertones. Brass, copper, bronze, and gold are commonly employed.

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AES News

1955 Interim Meeting Canceled; Candidates for Third Vice-President in March Issue of Plating

The Executive Board advised against holding of a 1955 interim meeting in view of the one-sided vote from AES delegates and alternates polled recently.

The totals in the voting were:

Question: "Do you favor the AES having an interim meeting in Indianapolis in early 1955?"

Delegates: no—55; yes—20

Alternates: no—22; yes— 6

Branches answering: 41

Since no interim meeting is to be held, candidates for Third Vice-President, usually introduced at that meeting, will be announced in the March issue of PLATING. Sponsors are requested to send in photos and publicity material by February 1 for this purpose.

Proceedings to be Published; Plating Subscription Increased

The Executive Board acted with disfavor on a recommendation to eliminate the publishing of the annual PROCEEDINGS but is looking into the possibility of improving this Society publication.

The 1954 PROCEEDINGS, scheduled for mailing in December, will contain all technical articles in PLATING in addition to convention papers.

This action was one of the many items on the Board's agenda during its meeting in New York.

At the same meeting the Executive Board authorized the increase of PLATING subscriptions to $5.00 per year for U. S. and Canada and $0.65 per issue. Foreign subscriptions remain the same. The effective date is "early 1955."

Smiles on faces of the AES Executive Board indicate satisfaction at the way plans are shaping up for the 1955 Industrial Finishing Exposition

Seated left to right around table are: Francis T. Eddy, third vice-president, AES; Samuel Heiman, second vice-president, AES; Eugene L. Combs, general convention committee chairman; Clyde Kelly, first vice-president, AES; George Burnley, advertising manager, PLATING Magazine; R. A. Schaefer, president, AES; P. P. Koratis, executive secretary, AES; G. P. Swift, past president, AES; Harold E. Bartlett, exposition manager; Albert W. Erickson, Jr., manager space sales, 1955 Industrial Finishing Exposition

Doria Appointed Editor of PLATING

Arch (short for Archimedes) Doria of Portland, Oregon, was named Editor of PLATING by the Executive Board in New York during its meeting there on Oct. 30-31. Doria was chosen from the nine candidates who were screened by the Board and those nine were the ones chosen from more than 100 who applied.

Doria comes to our organization with more than 15 years in the writing and publishing fields. At one time he was associated with McGraw-Hill as editor of several of their magazines.

The new editor is 40, married, and served with the 9th Air Force in World War II. He holds a Captain's rank in the Signal Corps Reserve.

Doria studied at New York University and at Tusculum College (Tennessee) and abroad. He has a background rich in the sciences.

Lee H. Morrison, whom Doria succeeds, left PLATING on October 15 to accept a position with a New York publishing house.

Going Over Editorial Board Plans

J. Winters, E. R. Bowerman, Jr., L. Diveley, F. Fulforth, R. A. Schaefer, A. McAleer, H. Wiesner and W. Geissman at October 1 meeting of the Editorial Board in Cleveland.

5th International Conference on Electrodeposition Joins AES Convention and Industrial Finishing Exposition in Detroit, 1959

The year 1959 looms as an historic episode in the annals of the AES and its Detroit branch, for that year brings to the Motor City three events of international importance—the 5th International Conference on Electrodeposition, sponsored by the Institute of Metal Finishing of England; the 46th Annual AES Convention; and the 5th AES Industrial Finishing Exposition.

This information was received recently from Dr. R. A. Schaefer, AES president, and AES past president Walter L. Pinner. Pinner, one of two official AES representatives to the Institute of Metal Finishing, was only recently informed of the English society's decision to join the 1959 AES convention and exposition.

Further plans will be announced in future issues of PLATING.

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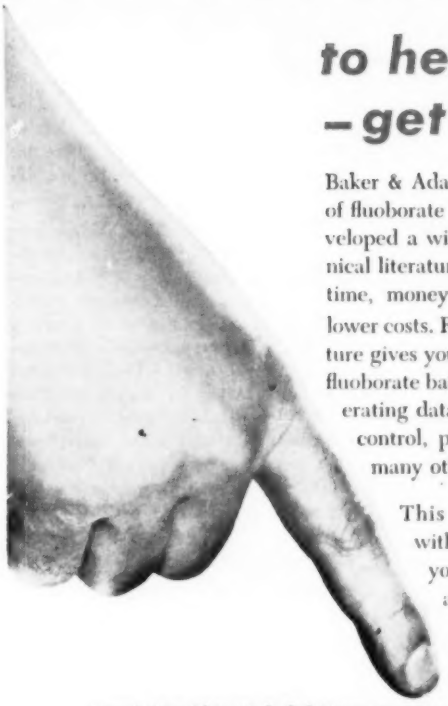

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☐ TC-36431 Plating of Baby Shoes
☐ TD-36431 Plating of Plastics
☐ TE-36431 Plating of Rotogravure Cylinders
☐ TF-36431 Manufacture of Sound Records
☐ TG-36431 Plating of Printed Circuits
☐ RA-36431 "Copper Plating From Fluoborate Solutions," reprinted from "The Monthly Review," official organ of the American Electroplaters Society, September, 1946.
☐ RB-36431 "Copper Fluoborate Plating Experiences," reprinted from "The Electroplaters and Stereotypers Magazine," June, 1953.

Ferrous Fluoborate

☐ TA-37641 Iron Plating of Stereotypes
☐ RA-37641 "Iron Plating Curved Stereotypes From a Fluoborate Bath," reprinted from "The Electrotypers & Stereotypers Magazine," July, 1952.

Fluoboric Acid

☐ TA-30691 Applications in Metal Finishing

Indium Fluoborate

☐ TA-37991 Indium Plating From Fluoborate Solutions

Lead Fluoborate

☐ TA-38351 Lead Plating From the Fluoborate Bath
☐ TB-38351 *Lead-Tin Alloy Plating From the Fluoborate Bath
☐ TC-38351 *Lead-Tin Alloy Plating in Electrotyping and Other Applications
☐ RA-38351 *"Metal Coatings Improve Solder Flow on Steel and Brass," reprinted from "Materials & Methods," May, 1949.
☐ RB-38351 *"Solderability of Lead-Tin Alloy Plating," reprinted from "Iron Age," December 8, 1949.

Nickel Fluoborate

☐ TA-40221 Barrel Plating
☐ TB-40221 Plating Stereotypes
☐ TC-40221 Plating Upon Aluminum
☐ RA-40221 "Barrel Plating with Nickel Fluoborate," reprinted from "Plating," October, 1950.
☐ RB-40221 "High Speed Nickel Plating of Curved Stereotypes," reprinted from "Electrotypers & Stereotypers Bulletin, March, 1950.
☐ RC-40221 "Nickel Plating From Fluoborate Solution," reprinted from "Plating," December, 1950.

Tin Fluoborate

☐ TA-43441 Tin Plating From the Fluoborate Bath
☐ TB-43441 Plating of Electrotype Shells
☐ TC-43441 Electrotinning of Copper Wire.

See Also Articles Marked*.

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AES News

Peripatetic Past President

National Past President Arthur W. Logozzo, President of the Nutmeg Chrome Corporation (Conn.), completed a tour of Texas, California, Washington, and Oregon branches in October. In Texas he presented a permanent charter to the San Antonio branch on behalf of the AES Executive Board; and at other branch functions, he talked on chromium plating and general Society matters.

Mrs. Logozzo accompanied genial "Art" in a trip which was described as "one of the nicest ever." More information on Logozzo's peripatetic adventures will be found in the Branch News section of PLATING starting in this issue.

First Vice-President Kelly Appoints Committee

From the Executive Board's meeting in Cleveland comes the announcement that First Vice-President Clyde Kelly has named the members of the "Broadening of AES Base Committee": R. F. Ledford, Chicago; S. S. Johnston, Cleveland; D. G. Foulke, Newark; G. S. Krentel, Los Angeles; J. Gurski, Detroit; F. G. Miller, Cincinnati; and K. M. Huston, Baltimore-Washington.

The important work this committee will accomplish would seem to be obvious, but the intricate difficulties it will meet in studying the problem are tremendous. Kelly has chosen well from among the able members. He will need all their combined abilities.

November Reports Show Plans for Convention Ahead of Schedule

Progress reports made by the various committees in charge of plans for the 1955 Industrial Finishing Exposition scheduled for Cleveland, Ohio, indicate the affair will be the biggest ever.

The reports were given at a recent meeting of the Executive Board of the American Electroplaters' Society.

The convention is slated to run concurrently with the 42nd annual convention of the American Electroplaters' Society, June 20 through 23 at the city's Public Auditorium.

Here are some of the latest developments as reported by Eugene L. Combs, general convention committee chairman, in conjunction with Leon Westbrook, exposition committee chairman.

(1) The over-all budget has already been submitted by the exposition management and approved. (2) Adequate housing has been blocked off in the city's leading hotels in anticipation of this year's exceptionally large registration. (3) Committee reports show all exhibitors renewing have contracted for more space than previously taken. More than 70 per cent of the selling space in the huge auditorium has been rented. (4) Plans for technical papers are already underway, many of the authors having already been selected.

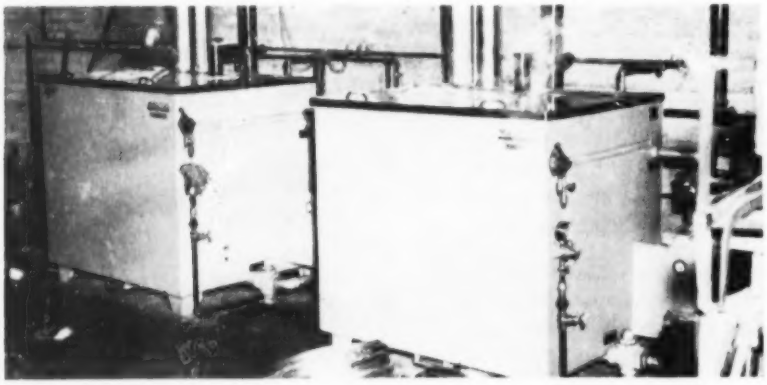
In addition, a gala week of entertainment has already been planned for the ladies: A fashion show; several teas; Plato Party; guided tour to the famous Westgate shopping center and a luncheon at the Lake Shore Hotel, featuring a Gay 90's program. A special luncheon and show at the Alpine Village Restaurant, one of the city's leading entertainment spots, heads the list.

The Athletic Committee reports arrangements made for golfing facilities at four of the city's leading golf courses for the men.

The Entertainment Committee reports the preparation of a special show by name entertainers. For the opening day of the convention there will be a special East-West softball game played at Edgewater Park.

The Cleveland Auditorium is considered an ideal site for the Annual Convention and Industrial Finishing Exposition. In addition to its spaciousness and all-inclusive facilities, it is located within walking distance from all the major hotels in the city.

Because all sessions of the meeting will be held under the same roof as that of the Industrial Finishing Exposition, it will be easy to visit the adjacent exhibit area in the Auditorium.



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All these results are obtained with the Magnus Aja-Lif Method of cleaning. Write for details.

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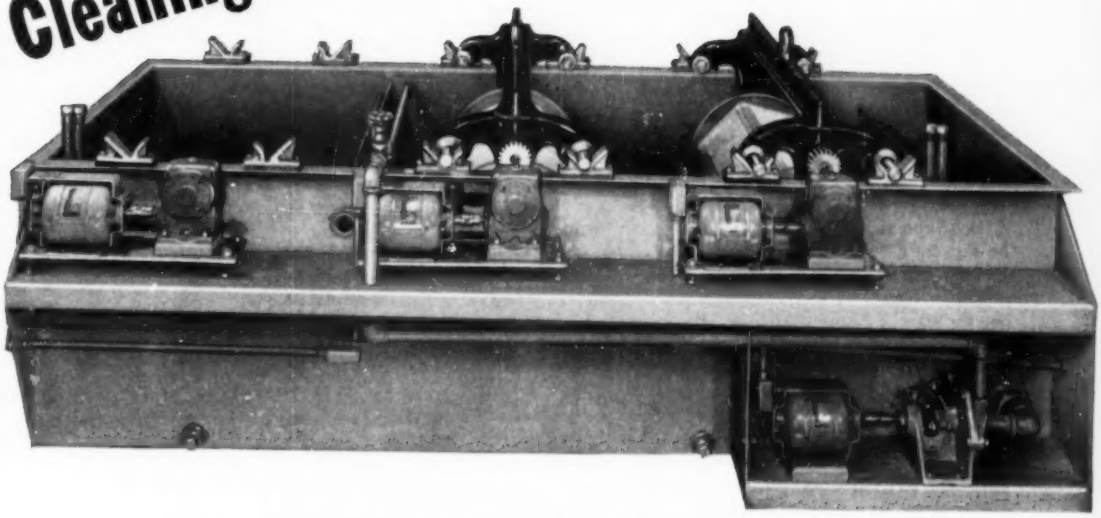

Stutz design in single or multiple units with or without rinsing compartment. Solution circulating pump for rapid elimination of surface grease into trap from which complete removal is made by simply draining of trap compartment daily.

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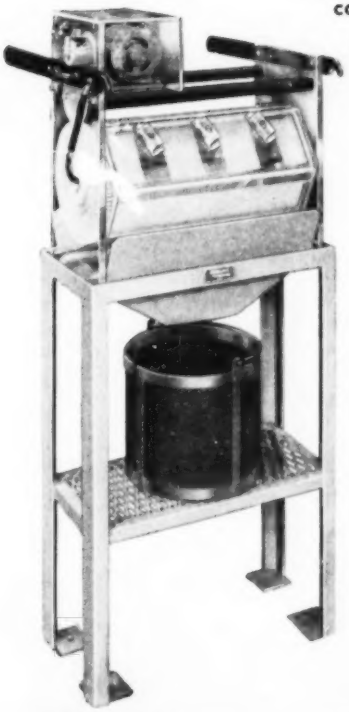

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Branch News

CAPITOL DISTRICT

The Capitol District branch met on 4 October 1954 at Pannetta's Restaurant in Menands. Following dinner, **J. W. Carroll,** Inorganic Research Department of the Pennsylvania Salt Manufacturing Company, presented "Acid Treatment Prior to Electroplating." This talk, accompanied by slides, showed how to select an inhibitor without having to worry about dragging it into a plating bath. President **Ted Infield** followed this with a brief business meeting.

The branch Christmas Party will be held at the Circle Inn at Latham's, N. Y. In addition to a talk by **Peter Kovatis,** executive secretary, there will be a grab-bag for all who bring a 25-cent gift; free beer, dancing, door prizes, and anything else that the Committee can dream up.

PAUL D. CALLAHAN, *Secretary*

CLEVELAND

The second meeting of the 1954–1955 was held on Friday, October 1 at the Carter Hotel, in spite of the deep mourning by Cleveland Indians baseball fans.

A group of 60 members and guests were present when President **Henry Friedberg** called the meeting to order.

It was our good fortune to have **P. Peter Kovatis,** executive secretary and managing editor of PLATING at this assembly. Kovatis introduced **E. R. Bowerman** and **Fred Fulforth** of the Editorial Board who were also in Cleveland for a board meeting of the AES. **Ed Bowerman** of Sylvania Electric Co. gave a brief talk on the various projects which are being scheduled by the AES Research Committee.

Henry Friedberg, our branch president, then turned the meeting over to **Ed Roehl,** librarian, who introduced the speaker of the evening, **R. W. Redmond** of the Murray Way Corp., Birmingham, Michigan. Redmond's subject was "Prefinishing of Steel Prior to Electroplating." The talk was illustrated with a good selection of slides which certainly proved the necessity of having the smoothest microfinish possible on strip steel prior to plating of automobile bumpers. Redmond, who was associated with the Oldsmobile Div. of G.M.C. for 32 years, emphasized the fact that with the huge investments being made in plating operations, the electroplating industry is no longer in the category of small business.

At the September 10 meeting, it should have been reported that a group of 15 new members were accepted by the local branch.

Refreshments were served through the courtesy of the Industrial Filter & Pump Mfg. Co.

MORT VAN LOAN,
Assistant Librarian

COLUMBUS

The monthly meeting of the Columbus branch was held October 1 at Battelle Memorial Institute, called to order by President **Bill Schickner** at 8:30 P.M.

Dick Jager reported on the progress made by the Tri-State committee. This committee will meet at Battelle on October 8 for further work.

A film featuring Udylite automatic plating equipment was presented.

Librarian **Bill Neill** then introduced the speaker of the evening, **James Viola,** president of Rapid Electric Company, who gave a talk on rectifiers. A question and answer session followed. The speaker for November will discuss sewage treatment.

The meeting was adjourned in favor of coffee and doughnuts, presented through the collaboration of **Bill Neill** and **Roger Cassidy.**

Michael Farr, Jr.,
Secretary-Treasurer

DAYTON

The October meeting of the Dayton branch was a dinner meeting held at the Biltmore Hotel on October 20. Thirty-one members were present at the dinner and eight more for the meeting at 8:00, called to order by President **John Easton.** Three new members were elected: **James D. Shane,** of Ruco, Inc.; **John S. Haddick** and **J. A. Welch,** both of Duriron Co., Inc.

Librarian **Holle Leuchauer** introduced the speaker for the evening, **C. F. Nixon,** head of the electrochemistry dept. of General Motors Research Laboratories, who gave a paper, "Plated Products on Cars." Nixon gave detailed data on the results of several surveys conducted over the past five years on the plated parts of automobiles from practically every state and province in North America. This paper proved to be quite interesting, as was shown by the numerous questions asked. Nixon was given a vote of thanks for this excellent paper, ably given.

The after-meeting refreshments were through the courtesy of Oakite Products, Inc., represented in this area by Dayton branch member **Arthur H. Horst.** Horst had as his guests four other members of Oakite Products; **Fred Brunning,** Division Manager and Cleveland branch member; **Hahn,** a Cincinnati branch member; **Fred Oliver** of the Automotive Div., and **Texier** of New York.

R. M. CLINEBENS,
Secretary

DETROIT

The first fall meeting of the Detroit branch of the AES was held on September 10, 1954 in the Statler Hotel.

President **Joe Gurski,** Ford Motor Company, opened the meeting and announced that **Dr. Ewing,** Professor at Michigan State University and director of AES Research Project No. 5, had died during the summer. **Ralph Eastman,** manager of the compound department of Frederic B. Stevens, Inc., also passed away. The chapter paid respects to these gentlemen who participated in AES activities. **Walter Pinner,** Houdaille-Hershey Corp., was awarded the Lea Medal for his work on mechanical finishing.

The October meeting of the Detroit branch was held on October 1, 1954 at the Statler Hotel. President **Joe Gurski** called the meeting to order at 8:30 P.M. with approximately 250 members present.

In the absence of **E. A. Steeger,** Joe Gurski turned the meeting over to **Glen Friedt, Jr.,** for the installation of delegates: **Herb Head, Don Bigge,** and **Lee Morse.**

Secretary **Bob Racine** informed the branch that eleven applicants were elected to membership in the Society, bringing the total membership to 647 members.

Herb Head's candidacy for 3rd Vice-President of the Supreme Society was announced.

This was "Stump the Experts" night. The four "specialists" who came prepared to answer questions from the members were: **Manuel Ben,** General Motors Research Division; **John Hitchcock,** Electrochemical Dept., DuPont; **Ed Kubis,** Wyandotte Chemicals Corp.; **Wright Wilson,** Auto City Plating Company.

Speakers Inspect Branch Program

E. R. Bowerman, Jr., member of Research Committee and Editorial Board; R. W. Redmond, Murray-Way Corporation, Birmingham, Mich.; Henry Friedberg, Branch President; and Fred Fulforth, Past AES President and member of Editorial Board. (Photo by Executive Secretary Kovatis)

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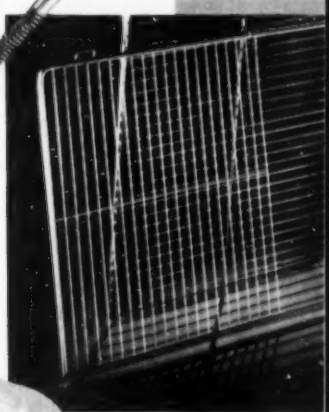

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Branch News

DETROIT

The annual technical session of the Detroit branch of the AES will be held at 8:00 P.M. on Friday, December 3, 1954, in the Statler Hotel.

Charles Conley, Houdaille-Hershey Corporation, Research and Engineering Division, will be the Honorary Chairman for the meeting, and will introduce the guest speakers for the evening.

Dr. George Dubpernell, Manager of Laboratories, United Chromium, Inc., Waterbury, Connecticut, will speak on "Industrial Applications of the Electrodeposition Processes." This talk will remind those who are closely connected with the automotive industry that the plating processes can be used under many different conditions and for widely varying end results than those that are commonly being used.

The second speaker of the evening will be **Dr. Ralph A. Schaefer,** Cleveland Graphite and Bronze of Cleveland, Ohio. Dr. Schaefer is national President of the AES, and the Detroit branch feels highly honored in having his presence at their annual technical session.

His subject wil be "A Qualitative Study of Macro and Micro Metal Distribution in Plating Baths." The talk will cover qualitative data for macro and micro metal distribution. The data was obtained by the plating of cyanide copper and silver, chromium, nickel, stannate tin and electroless nickel on flat and formed cathodes with or without pores.

The Detroit branch would like to extend a cordial invitation to all members and guests outside of the Detroit branch to attend.

JOHN DRINKWATER,
Public Relations

GRAND RAPIDS

The October 8 meeting of the Grand Rapids branch was a gala affair. It was Ladies' Night, when all business and electroplating know-how was absolutely forgotten. Everybody just relaxed and enjoyed a very fine social evening. The party was held at the "Yellow-Jacket," a night-spot located about 20 miles west of Grand Rapids. One hundred six members and their wives attended!

After the dinner, President **Carl Green** cordially welcomed the ladies, whereupon he and **Perry Burnham** proceeded to draw names for the door prizes. There were so many gifts that nearly all the ladies won something. Over eighteen supply houses contributed these gifts for the happiness of the ladies. "Gorgeous Gifts for the Gals" was the theme of the evening. All the ladies were delighted with their gifts. To all the contributing supply houses which made these splendid gifts possible, we extend our sincere gratitude.

After the tables were cleared **"Doc" Mustee,** Master of Ceremonies for the evening, called the group together to dance the "hokey-pokey" and then the "bunny-hop." This dance proceeded around the hall but was stopped for fear some of the ol' timers would have a heart attack. While the group recuperated from this later dance, "Doc" Mustee did a few impersonations. The one of Jimmy Durante at the piano was particularly good. Everyone thought we should have another party like this again next year.

To President Carl Green, the branch officers, and to the supply houses, we all say this was truly one of the best Ladies' Night meetings our branch has ever had.

KENNETH HAMPEL,
Publicity Chairman

HARTFORD

The regular branch meeting was held at the Bond Hotel on October 18 and 67 members and guests were present. Before the meeting **Ralph McCahan** briefly reviewed two papers that were presented at the New York convention entitled "Levelling in Acid and Cyanide Copper Baths." A short movie of the Fall outing in September taken by **Ed La Croix** of the entertainment committee, was shown.

The guest speaker for the evening was **Thomas Christiansen** of the Dow Chemical Co., whose subject was "Modern Vapor Degreasing."

Christiansen briefly reviewed the history of vapor degreasing and then discussed the properties and differences of trichloroethylene and perchloroethylene as used for degreasing. The types of machines were shown by the use of slides that are presently used and the troubles that may be encountered were pointed out. The effects of water and aluminum on the breakdown of the solvents and corrosion from the breakdown products were discussed. A new cold degreasing fluid, less toxic than carbon tetrachloride, called Chlorothene, was mentioned.

The technical chairman for the evening was Ed La Croix.

STANLEY PLATOZ, *Secretary*

HOUSTON

The October meeting of the Houston branch was held at the Ben Milam Hotel on October 19 with 17 members and 10 guests present.

N. S. Dunaway, James E. Savoie and **Thomas L. Fields** were elected to membership.

The speaker was **Arthur Logozzo,** Past President AES and President of the Nutmeg Chrome Corp. He showed an interesting film on the continuous high speed electrotinning line at Weirton Steel, and a color film on hard chrome plating, with particular emphasis on stop-offs and anode spacing.

Slides covering various aspects of hard chrome plating followed, and the meeting was concluded with a general discussion of chrome plating problems.

LOUISVILLE

The regular monthly meeting of the Louisville branch, AES, was held Thursday, September 16, at Kapfhammer's Party House, in Louisville, with a dinner served at 6:30 P.M. President **J. W. Scholl** opened the meeting at 8:00 P.M. with 28 members and guests present.

Technical sessions chairman **S. J. Beyer** reported that the October meeting will be a Ladies' Night—special program meeting. We will have **Al Aronson,** columnist of the Louisville Times as the speaker and also a movie entitled, "A is for Atom."

President J. W. Scholl appointed by proxy **William Young,** of the Cincinnati branch, to represent the Louisville branch at the October 8 meeting of the Tri-State regional meeting. The President also appointed **J. G. Sterling** as a delegate to the meeting, which will be held at Columbus, Ohio, some time in the Spring of 1955.

Richard G. Marshall was appointed to the office of sustaining membership chairman.

Stanley J. Beyer, as a delegate from the Louisville branch AES to the National Convention, which was held in New York City, in July 1954, gave a very fine report of the convention and its activities. Stanley also announced that the speakers list for the balance of the fiscal year was completed.

President J. W. Scholl turned the meeting over to educational chairman Stanley J. Beyer who, after a brief talk, introduced **H. M. Goldman,** assistant sales manager of the Enthone Company, New Haven, Conn., as the speaker of the evening. Goldman spoke on the subject of Coloring of Metals which may be summarized as follows:

1. In coloring of metals, corrosion resistance, fine and uniform color and quality of the finish are of real importance.
2. Immersion coatings can be made into fine antique finishes by rubbing, buffing, and other necessary work to make a fine quality job.
3. Several other methods have been found to obtain fine finishes by conversion coatings; such as oxide coatings. These coatings must be abrasive resistant and also resistant to discoloration. Anodize coatings of aluminum is one of these and many different colors can be obtained in the electrolytic sulfuric acid process.
4. Chromic acid and oxalic acid also can be used for anodizing of aluminum. There are also many patented processes; such as the Alrok, Pylumin, and the Aluminox. In the process of coloring of aluminum we now can dye any shade and have a very high gloss finish including

hardness and finger print resistance.

5. Coloring of zinc and cadmium can be obtained by chromate conversion coloring and many patented processes; such as the Anozine process by the United Chromium Corporation.
6. Copper and its alloys can be finished by the sulfide immersion process to obtain fine finishes by buffing, brushing, and lacquering. But these coatings are not stable and have practically no corrosion resistance.
7. Iron and steel can be finished by the use of nitrates and nitrites including caustic solutions with some variations for gun metal finishes. Some phosphate coatings can be dyed but do not have wear resistance and must be lacquered.
8. Stainless Steel can be colored with the sulfuric acid method with color added at 700° F. It is not stable but a very dangerous application and operation.

Slides were shown and explained. Considerable discussion followed, and H. M. Goldman was given a rising vote of thanks for a very interesting talk.

An Armed Forces Information film was presented after the talk.

J. G. STERLING, *Secretary-Treasurer*

MELBOURNE

The 90th regular meeting of the branch was held on September 16 at the Melbourne Technical College.

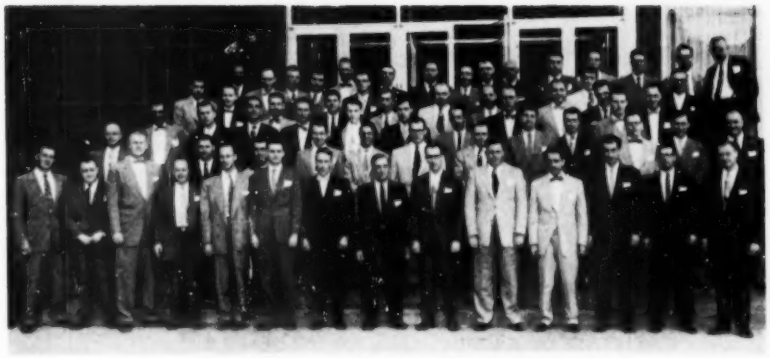
Prior to commencement of the meeting, three short films were shown. Five applications for membership from the following people were accepted during the course of the meeting: **S. G. Anderson, T. T. Brown, D. F. Cowan, K. W. Russell,** and **K. S. Williams.**

The speaker for the evening was **I. A. Newland,** chemist, of the Ordnance Factory, Maribyrnong. Although his address was entitled "Simple Methods of Solution Testing" he preferred to have it known as "Testing Methods Made Easier" since the lecture was not for the chemist or the metallurgist, but for the everyday plater.

He stated that proprietary solutions were usually covered by the manufacturer's recommendations. When commencing his own control, the plater is confronted with the following queries: (1) Is his chemical knowledge sufficient? (2) What equipment is required? (3) The time and accuracy required. (4) The cost and ultimate value to the job.

An outline of the techniques used when handling apparatus was presented and Newland pointed out the various methods of determining constituents of plating solutions; to demonstrate the handling of the various pieces of volumetric glassware; processes used during the analysis including electrolysis, filtration, precipitation, etc.; the use of the correct grade of filter paper to reduce time of filtration. The use of various types of indicators were mentioned, and the speaker concluded by quoting "Chemical control never was and never will be a substitute for good housekeeping in the plating shop."

R. W. LENNIE, *Honorary Secretary*



Pittsburgh branch visits Weirton Steel

MILWAUKEE

The first lecture meeting of the 1954–1955 season was at the Ambassador Hotel on October 1, with 53 members present.

A well directed effort has been made by **Art Lynn,** Librarian, to obtain a well-balanced series of discussions for the year. This was led by an interesting talk on "Levelling by Electroplating" by **W. H. Safranek,** of the Battelle Development Corporation, of Columbus, Ohio.

Safranek covered the basic considerations involved in the broad concept of levelling. Great interest was generated.

An all-out effort is being made to increase attendance and membership. To further this, a Roving Committee on Membership and Reception Committee has been established. **John Schneider** is Chairman of the Roving Committee, with **Steve Choren, E. McCoy,** and **John Wagner** as members. The Reception Committee consists of **Hank Bornitzke, Phil Ritzenthaler, Vincent Mattacotti,** and **Harry Kreuger.** McCoy announced an innovation to build attendance: offering a door prize at each meeting, and started the ball rolling with a donation from his company, the George Stutz Co.

Phil Ritzenthaler announced that a floral offering had been sent in the name of the Chapter to **Mike Doyle,** who passed away quite suddenly.

Our President, **Glen Schwemer,** announced that the 21st Annual Pinner Dinner will be held November 5, at North Hills Country Club.

LON WARNECKE, *Assistant Secretary*

NEW HAVEN

The monthly meeting of the New Haven branch was held on September 14, 1954, in the Mason Laboratory of Yale University.

The meeting was called to order by President **Edward Busby.** After the reading of communications and the treasurer's report the fall program was discussed in regard to membership and the annual Christmas party to be held on December 3, 1954.

An application for membership was received from **Edward Jorczyk. Edward Foley** was transferred from Newark to New Haven. Ed gave a brief résumé of his course on electroplating being given in New Haven Teachers College. **Al Ferguson** spoke in behalf of a similar course being offered at the University of Bridgeport. **John Barry** reminded the members that the city of Bridgeport is once again offering a free course in electroplating in Central High School.

The technical chairman for the evening, John Barry, then introduced **Ray O'Connor,** president of Contract Plating Company, Bridgeport, who discussed his trip to Ireland and then gave a report on the International Conference of the Institute of Metals which was held in London. He stressed the fact that American opinion and experience was solicited. Europeans, in general, leave many of the practical concepts of the subject to others and prefer to deal in the pure sciences. They are 15 years behind us in many respects and have little in the way of automatic equipment, but they are making rapid progress and taking advantage of their lower labor costs to capture foreign markets.

BERNARD GAFFNEY, *Secretary-Treasurer*

PITTSBURGH

The Pittsburgh branch in place of its regular meeting held a special program at Weirton, West Virginia. Testimony as to the interest created by this program was attested to by the unusually large number of members and guests who participated.

Included in the activities for the day was a tour of the Weirton Steel Company Tin Mill facilities. Weirton, the largest independent manufacturer of electrolytic tin plate was the pioneer in developing the halogen tin process and dual coated strip. Among the highlights of the tour was the witnessing of the cleaning, annealing, temper rolling, plating, shearing and packaging of tin plate that would

eventually be made into cans for food containers.

Upon completing the tour the group reassembled at the beautiful new Community Center in Weirton for an excellent chicken dinner provided by Weirton Steel. At the conclusion of dinner a few words of welcome were extended to the Society by **J. J. Munns**, Vice-President of National Steel Company, Great Lakes Steel Company, and Weirton Steel Company who has been one of the leaders in developing electrolytic tin plate in this country.

After a brief business meeting Librarian **Fred Dixon** introduced our speaker for the evening, **J. A. Swift**, President of Swift Industrial Chemical Company. His subject was "Manufacture, Rolling, Cold Working of Steel and how these Factors May Affect Plating." He illustrated his very informative talk with an excellent set of slides he had collected over the years that showed various factors inherent in steelmaking that would have a direct relation to the finish obtained on the plated product.

After the drawing for the door prize a lively discussion period followed on problems encountered with plating cold rolled steel.

Glade Bowman was the lucky recipient of the door prize, a Westinghouse Automatic Toaster presented by **Bill Wilson** of Pennsalt Manufacturing Company.

The meeting was adjourned with a rising vote of thanks to **R. Varner** for arranging the program and to Weirton Steel Company for sponsoring the day's activities.

HERB SCHRAM, *Secretary*

PORTLAND

The regular monthly meeting was held at Berg's Chalet, 20 members and guests attending.

After a brief business meeting, a very fine talk by **Earl W. Arnold** of L. H. Butcher Company, Los Angeles, California, on various types of copper plating was enjoyed. An open forum discussion followed.

KEN HUMPHREY,
Secretary-Treasurer

ROCHESTER

The meeting was held on October 18 at the 45 & 8 Club, University Avenue, Rochester, New York. We were honored by the presence of **P. Peter Kovatis**, Executive Secretary, who spoke briefly on the National Society affairs on research and development projects.

The main speaker of the evening was **Dr. H. L. Kellner**, Technical Director of Len Manufacturing Company, Waterbury, Connecticut. In his discussion of "Bright Copper Plating," he covered the evolution of copper plating from its origin to the present high-speed bright-copper solutions. Dr. Kellner has a wealth of background in the plating and finishing field and is an author of several articles in this field.

William Stenzel's application for membership to AES was accepted and approved by the branch members.

FRED JOHNSON, *Secretary*

ROCKFORD

The first meeting of the Rockford branch AES was held at the Faust Hotel, President **Vern Wissen** presiding.

A date was set for the annual Educational Session and Banquet to be held April 16 at the Faust.

H. Rewerts reported on the Stag Picnic held in July.

C. Pickering reported on the annual Plae-Dae (held at Mauh-Nah-Tee-See Country Club) which is getting more popular each year.

Librarian **Lawrence Ray** introduced **Robert Twyning** as speaker of the evening. His topic was "Technology of Liquid Buffing Compositions," which had been given at the National Convention in New York in July.

Twyning's talk described the theoretical chemical as well as the practical aspects of cleanability, emulsion stability, viscosity, cutting power and wheel facing to reduce buff consumption. His paper also described emulsifiers, protective colloids, surface agents, abrasive impurities in the emulsion, processing technique and colloidal particle size.

E. J. BUDDEN, *Secretary*

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Branch News

SAN ANTONIO

AES Past President **Arthur W. Logozzo,** of Nutmeg Chrome Corporation, delivered a talk on "Hard Chrome Methods" and presented the branch with its permanent charter at its regular meeting on October 18, the 45th anniversary date of the founding of the AES. Logozzo reminded the group that even the largest branches started as small ones.

In addition to the talk and movie on hard chrome, Logozzo surprised the branch with a movie of the Weirton Steel Corporation electrotinning operation.

TOM COLLARD, *Publicity Chairman*

SAN FRANCISCO

The monthly meeting was held at Pastore's Restaurant in Redwood City on September 9, 1954, with 25 members present.

John Festa of Sylvania Electric Company, Mountain View, was the speaker for the evening. He spoke on current distribution in plating baths, methods for determining the flow of current, and processes used to determine the amount of current in the bath.

Festa was a delegate to the National Convention, and he also gave a brief summary of the proceedings at the convention.

At the business session a committee was selected to contact members who had not paid their dues. This committee consisted of **Floyd W. Browning,** chairman; **J. R. Pattenger, C. Mattman.**

The application of **Wallace E. Davis** of Prescolite Manufacturing Company, Berkeley, was approved, and he was elected to membership.

FLOYD W. BROWNING,
Secretary-Treasurer

SEATTLE

The regular monthly meeting of the Seattle branch was held on October 20, 1954 at the Stewart Hotel, with a dinner preceding the meeting.

About 35 members and guests enjoyed hearing **Earl Arnold** of the L. H. Butcher Company, review the paper given several years ago at the AES convention on cleaning and plating of zinc die castings.

William Gilbert of the Chromium Corporation, Seattle, Washington, had introduced Arnold to the group with the idea that L. H. Butcher Company is a supply company and would probably be able to fill any need on a visit to that area from hotel reservations to a blind date with a movie star. Arnold would not guarantee the date with the movie star.

HELEN ARCHIBALD, *Secretary*

SOUTHEASTERN

Our regular monthly meeting was held on Friday evening, October 8, at the Belmont Steak House, **Ray Chas. Steffey** presiding.

It was suggested by our past president, **H. R. Stogner,** that the Southeastern branch sponsor a course of plating through some good school in Atlanta with the hopes of making more young men with some knowledge of the business available to the plating industry of this section of the country. It was moved that a committee be appointed to look into the possibilities of such a course and report at the next regular meeting. The following members were appointed: **Chas. Anger,** Parker Rustproof chairman; **H. R. Stogner,** Atlanta Plating Works; and **Milton Jones,** of Simmons Plating Works.

Our speaker of the evening was none other than our good friend **William F. Kelly** of Southern Lead Burning Co., Atlanta, Georgia. Bill gave us a very enlightening talk on the history and uses of lead.

W. T. WEYMOUTH,
Secretary-Treasurer

SOUTHERN TIER

The Southern Tier branch held a meeting at the Ah-Wa-Ga Hotel, Owego, N. Y., 21 September 1954.

The meeting was called to order at 7:50 P.M. by President **George Zurenda. Stefanski** reported that **Robert Guffie** of United Chromium, Inc., is the speaker for the 19 October meeting at Waverly, N. Y. **Rood** reported on his contacts with potential new members. **Zurenda** elaborated on getting new members and transferring members of other branches into the Southern Tier branch. The position of board of managers held by **George Crandall** was voted to be vacant. The secretary was advised to make an immediate application for a permanent charter.

The meeting was opened to general discussion of plating problems and metal finishing. **Conway** discussed his experiences in plating steel parts with zinc due to shortage of nickel. **Bound** talked on the treatment of aluminum before painting. **Cordier** discussed copper plating of steel parts prior to carburizing. **Rood** talked on the plating of zinc die castings. **Lott** spoke on treating parts with ferro-ferric cyanide dip to give better adhesion prior to zinc plating.

A general discussion on chrome plating revealed baths operating at many concentrations and temperatures. In analyzing chrome baths, **John Conway** questioned the reliability of the sulfate ratio due to the water contaminants such as chlorides and fluorides as added by the water bureaus. Rhodium plating was discussed, particularly the application of contacts. Its wearing qualities are superior to silver gold. **Fletcher** spoke of incorporating organic finishing into the branch since many of the members do organic finishing or prepared parts to paint. A speaker on organic finishing will be contacted for one of the later meetings.

SYRACUSE

The Syracuse branch held the October meeting at Bill Richard's restaurant, 106 Ashdale Avenue, Syracuse, New York, on October 18, 1954. Twenty-four members attended the dinner and 32 were present for the meeting which followed.

The speaker of the evening was **R. O. Hull** from R. O. Hull Company. His topic was "Plating Measurements."

Refreshments were provided by **Ed Hollister,** of Frederick Gumm Chemical Co.

A. G. MARTINEAU, JR.,
Recording Secretary

TORONTO

Forty-one members of the Toronto branch attended the dinner session of the October 8 meeting and twenty-five more arrived later to hear the speaker. The speaker was **E. Rinker,** vice-president of Sel-Rex Precious Metals. He was introduced by **Art Severs,** president of the Armalite Co.

Rinker gave a very interesting talk on Precious Metal Plating. He pointed out that 15 to 20 years ago, gold, silver and rhodium were used only in the decorative field. Now there are many industrial uses for them in the Aircraft and Electronics fields for bearing surfaces, good electrical contacts, and corrosion resistance.

The most important advance in silver plating has been the introduction of a bright silver bath which eliminates buffing in decorative plating. In the industrial field, carbon bi-sulfide or ammonium thiosulfate are still good enough to produce smooth, uniform, ductile plates. In the plating of bearings, 50 per cent or more of the surface is removed. Good deposits can be plated at 0.004 inch per hour. Stainless steel inside anodes are used and constant filtration and agitation are required.

Rhodium was first developed to plate Army reflectors replacing silver which tarnished easily. The most widespread use of rhodium plating now is the costume jewelry field. The industrial uses are limited to sliding electrical contacts.

Gold is very versatile and can be deposited in light or heavy deposits and dull or bright. Bright gold gives good coverage and corrosion reistance and can be deposited in any thickness. Some of its uses are in plating lighters, watchcases, pens and automotive hardware.

J. G. SMITH, *Branch Correspondent*

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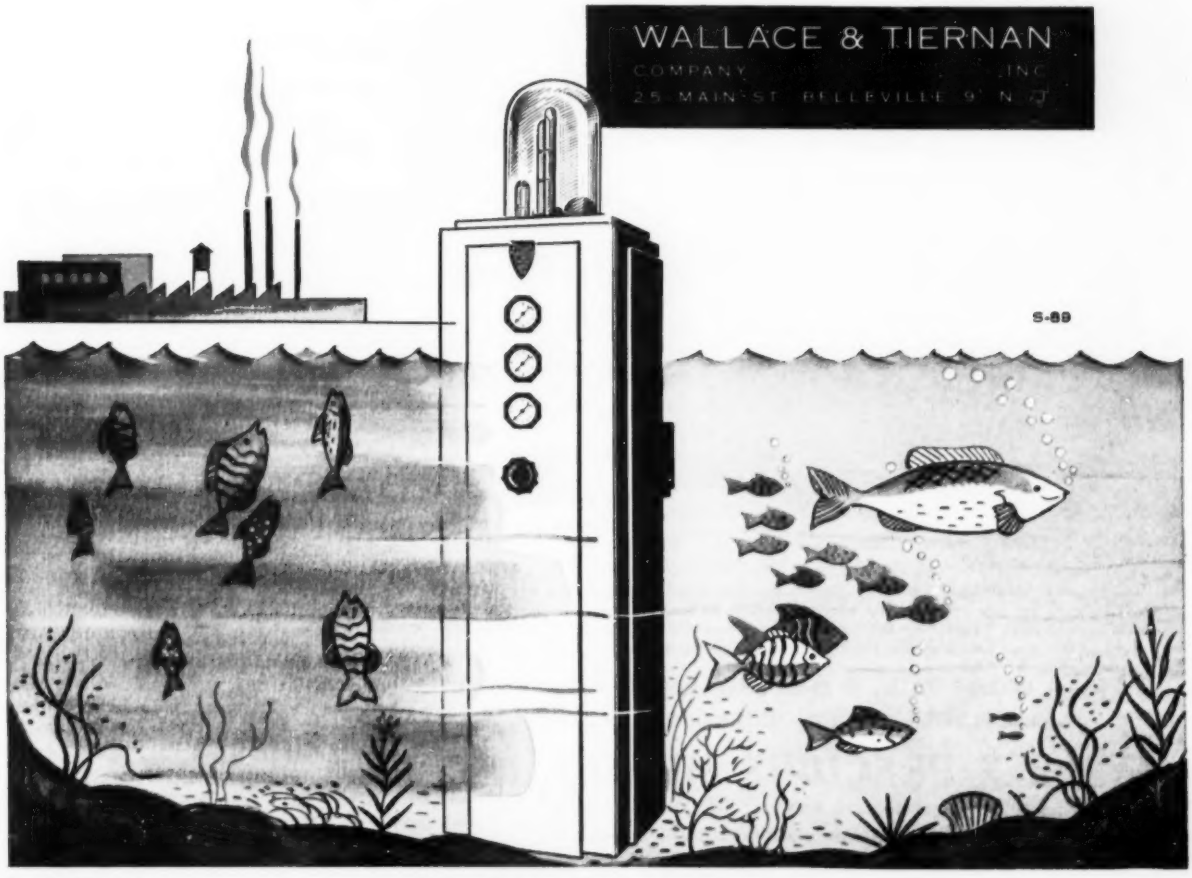

AES Membership Changes

Elections

BRIDGEPORT: Robert F. Richards
CENTRAL MICHIGAN: Francis E. Gazlay, Leslie J. Hanlon
CLEVELAND: Clarence E. Hayes, A. R. Laughlin
DAYTON: John S. Haddick, James D. Shane, J. A. Welch
DETROIT: Volney P. Bayley, Victor P. Boka, Jr., Joseph D. Brody, Charles E. Hutchinson, Carl N. Johnson, Jay W. Smith, D. P. Sorolis, Charles E. Tackels, Jr., David Tann, Gim Y. Yee, Henry Zielinski
HAMILTON: Norman A. Graham
HARTFORD: J. M. Brewer, J. Pelosi
HOUSTON: N. S. Dunaway, J. E. Savoie, T. L. Fields
MELBOURNE: S. G. Anderson, T. T. Brown, D. F. Cowan, K. W. Russell, K. S. Williams
MILWAUKEE: Frank H. Marshall, Louis S. Winter
NEW YORK: Richard Baier, Jack Beller, Andrew Calvert, Norman Feldman, Irving Gold, Samuel Heller, Gabriel Kassakian, Joseph A. Rembecki
PHILADELPHIA: John C. Instone, Charles E. Joseph, John La Ruffa
ROCHESTER: William F. Stenzel
ROCKFORD: Gordon C. Prather
SAN FRANCISCO: Justin B. Call, Wallace E. Davis, M. E. Hegendeffer, Fred Herman, Floyd Jenson, Andrew S. Pugliarissi, Arthur E. Schwartz
SEATTLE: Herbert E. Adams, John C. Corl, Carl C. Deardorff, Arthur F. Doll, Jr., W. J. Marquardt, E. W. Stebor
SOUTHERN TIER: William B. Rossiter, Roger W. Wheeler
SPRINGFIELD: Myron Niedzwiedz, Stuart E. Sinclair
SYDNEY: Mrs. I. B. Coulson, W. H. Coulson, W. Harrison, M. R. Mackinnon, C. G. Mizon
TORONTO: E. E. Hanna, W. B. Stratton
WATERBURY: John P. Schafer
MEMBER-AT-LARGE: M. Lewin e' Hijos, Buenos Aires, Argentina

Reinstatements

ALLENTOWN-READING: Murray H. Abbey
BUFFALO: N. Bartole
CHICAGO: K. J. Ackerman, Frank K. Savage
NEW YORK: M. Rubenstein
PHILADELPHIA: James F. Green, Marion E. Bayne
ST. JOSEPH VALLEY: Bruce E. Wallace
MEMBER-AT-LARGE: Laurens J. M. Teepe

Transfers

CENTRAL MICHIGAN: Alfred G. Lee to Grand Rapids
CHICAGO: Frank K. Savage to Grand Rapids
CLEVELAND: Jack Kershaw to Detroit
DALLAS-FT. WORTH: Othia H. Kernodle to Indianapolis, Clinton Murray, from Houston
DETROIT: William N. Dunlap, Jr., to Philadelphia, Edward Finnie to Springfield
ROCHESTER: Platt K. Wiggins, Jr., to Buffalo
SAN FRANCISCO: Charles H. Wirth to Louisville
SYRACUSE: Harry M. Herlikofer to Southern Tier
TOLEDO: Philip C. White to Saginaw Valley
TORONTO: J. Fullerton from Montreal
MEMBER-AT-LARGE: Thomas H. Adams to Seattle, Lloyd P. Sharts to Seattle

Resignations

BUFFALO: C. L. Monk
DALLAS-FT. WORTH: Samuel Witkoff
DETROIT: Dorothy E. Forbes
NEW HAVEN: Dr. E. Egeberg, Frank J. Kirchner, V. Koppel, E. R. MacNicholl

Suspensions

BUFFALO: F. Kieffer
CHICAGO: Albert O. Bruder
DAYTON: Fred M. Topping
DETROIT: Webster B. Knight, Jr., Clifford T. Olsen, John W. Ward, Jr.
MILWAUKEE: Eli Allen, Theodore Klinker, James Poulson, Edward Wroblewski
NEW HAVEN: Raymond C. Kendall, Maurice J. Leahy
NEW YORK: WilliamRice
PITTSBURGH: Damon C. Antel, Wilfred N. Barbian, Richard A. Dimon, Harry A. Early, Leonard R. Hoak, Emmett Leopardi, M. A. Pederson, Frank D. Porter, R. Plass, J. C. Tervay
WICHITA: Donald Van Berchtold

Deaths

MILWAUKEE: Omer N. Doyle

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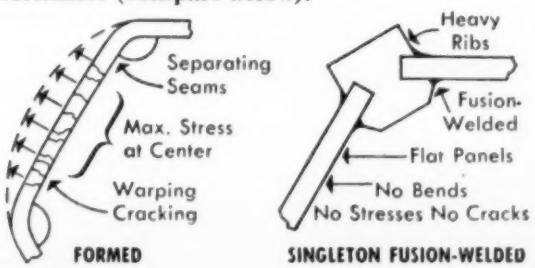

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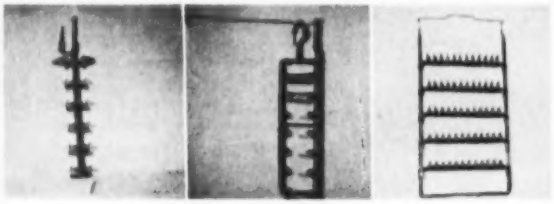

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AES RESEARCH COMMITTEE

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ADELAIDE meets second Wednesday of each month. Secretary, R. J. Down, Room 30, 17 Currie Street, Adelaide, S. A., Australia.

ALLENTOWN-READING meets third Wednesday of each month in Scotty's Anchorage, Second and Main Streets, Emmaus, Pa. Secretary-treasurer, Edgar H. Iobst, Jr., 163 Main Street, Emmaus, Pa. Research finance committee chairman, Lee C. Wotring, 526 N. St. Elmo Street, Allentown, Pa.

BALTIMORE-WASHINGTON meets second Tuesday of each month with meetings in Baltimore at the Engineers' Club and in Washington, D. C., at the National Bureau of Standards. Secretary, Carl H. Thiede, 8426 Piney Branch Road, Silver Springs, Md.

BOSTON meets first Thursday of each month in Hotel Statler. Secretary, Dr. George P. Swift, 53 Galen Street, Watertown 72, Mass. Research finance committee chairman, Louis V. Gagnon, 53 High Street, Natick, Mass.

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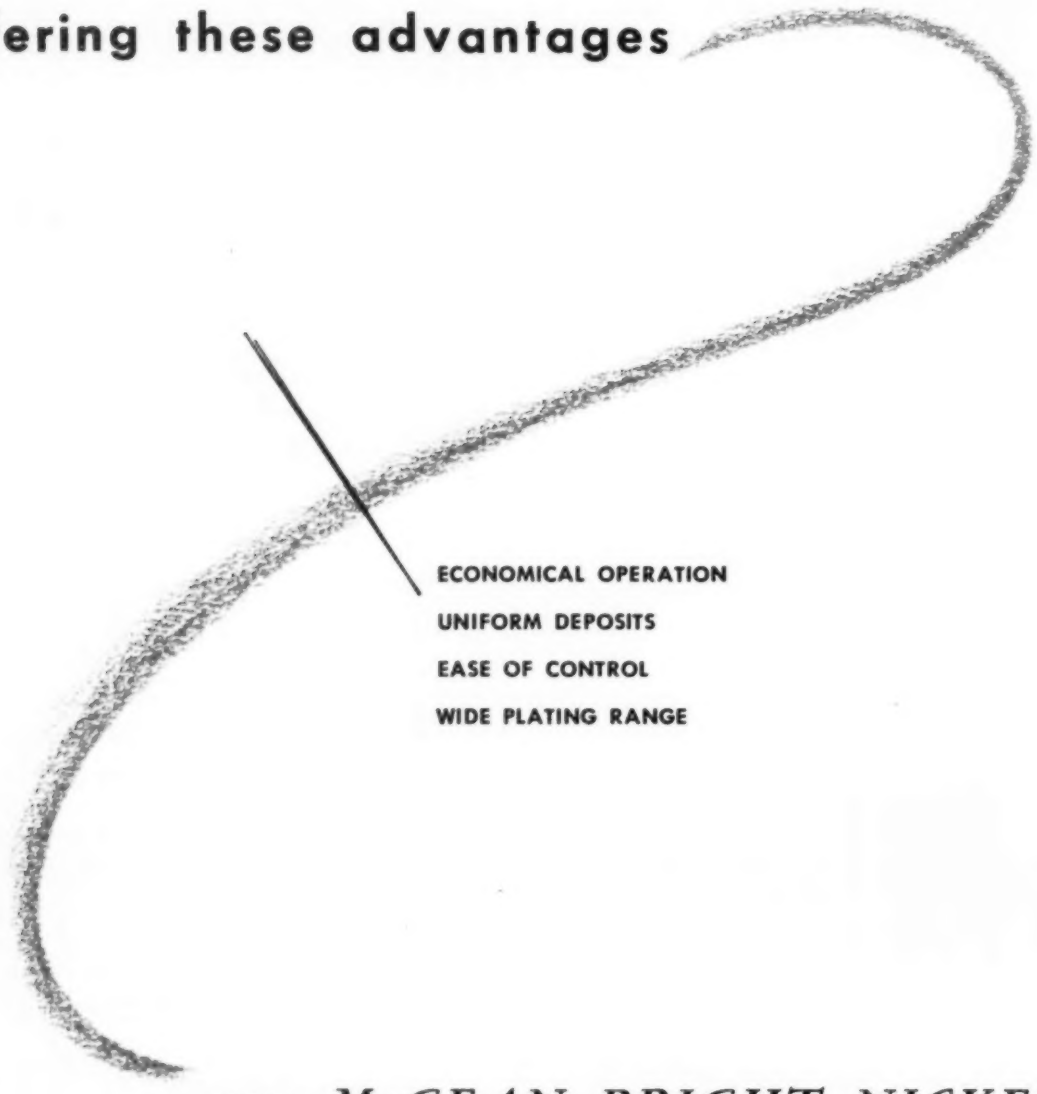

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BRIDGEPORT meets second Friday of each month in Barnum Hotel. Secretary-treasurer, Robert G. Parker, 25 Beverly Road, Bridgeport 58, Conn.

BUFFALO meets first Friday of each month in Markeen Hotel. Secretary, Eric G. Sampson, Jr., 43 W. Main Street, Falconer, N. Y.

CAPITOL DISTRICT BRANCH meets first Monday of each month at Panetta's Restaurant, Menanda, N. Y., at 7:00 P.M. for dinner; educational session at 8:00 P.M. Secretary, Paul D. Callahan, 1855 Becker Street, Schenectady 7, N. Y.

CENTRAL MICHIGAN meets second Tuesday of each month alternating between Meadow Lark Inn in Jackson and Porter Hotel in Lansing. Secretary-treasurer, E. J. Bosca, 411 Third Street, Jackson, Mich. Research finance committee chairman, G. S. Woodruff, 2424 Dawn Avenue, Jackson, Mich.

CHICAGO meets second Friday of each month at 8 P.M. at Western Society of Engineers, 84 E. Randolph Street. Secretary-treasurer, Paul Glab, 882 N. Paulina Street, Chicago 22, Ill. Research finance committee chairman, Charles Geldzahler, c/o Platers' Technical Service, Inc., 509 S. Wabash Avenue, Chicago 9, Ill.

CINCINNATI meets fourth Wednesday of each month at 6:30 P.M. in Engineering Society Headquarters, McMillan Street and Woodburn Avenue. Secretary, L. J. Howald, 6265 Wiehe Road, Cincinnati 13, Ohio. Research finance committee chairman, C. R. Sorber, 2004 Connecticut Avenue, Cincinnati 24, Ohio.

CLEVELAND meets first Friday of each month in Hotel Carter at 8 P.M. Secretary-treasurer, A. J. Lupien, 4408 Carnegie Avenue, Cleveland 3, Ohio. Research finance committee chairman, to be appointed.

COLUMBUS meets first Friday of each month at 8 P.M. in Battelle Memorial Institute Auditorium. Secretary-treasurer, Michael Farr, 1735 Franklin Ave., Columbus 5, Ohio. Research finance committee chairman, to be appointed.

DALLAS-FORT WORTH meets third Wednesday of each month at 6:30 P.M. in Lennox Hotel, Grand Prairie, Texas half-way between Fort Worth and Dallas. Secretary-treasurer, research fund chairman, A. C. Fricke, 212 Julien Street, Dallas 3, Texas.

DAYTON meets third Wednesday of each month in the Biltmore. Secretary, Richard M. Clinebens, 33 W. Market St., Germantown, Ohio. Research finance committee chairman, Richard F. Moore, 526 Aberdeen Ave., Apt. B, Dayton 9, Ohio.

DETROIT meets first Friday of each month in Hotel Statler at 8 P.M. Secretary-treasurer, R. J. Racine, c/o Wyandotte Chemicals Corporation, Wyandotte, Mich. Research finance committee chairman, H. J. McAleer, 3171 Bellevue, Detroit 7, Mich.

GRAND RAPIDS meets second Friday of each month at Fingers Restaurant at 7 P.M. for dinner; educational session at 8:15 P.M. Secretary, John Dykstra, 104 Celia, S. E., Grand Rapids, Mich. Research finance committee chairman, R. O. Watson, 2206 Nelson S. E., Grand Rapids, Mich.

HAMILTON meets third Thursday of each month in the Conference Room, West End Plant, Canadian Westinghouse Company, Ltd. Secretary, R. Burke, c/o Swift Devices, 14 George Street, Hamilton, Ontario, Canada.

HARTFORD meets third Monday of each month in Hotel Bond at 7:45 P.M. Secretary, Stanley Platoz, 26 Erwin Place, New Britain, Conn. Research finance committee chairman, Frank W. Smith, 46 Cottage Street, Meriden, Conn.

HOUSTON meets third Tuesday of each month at 7 P.M. in the Ben Milam Hotel, Houston, Texas. Secretary-treasurer, H. L. Mauzy, P. O. Box 2119, Houston 1, Texas.

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INDIANAPOLIS meets first Wednesday of each month at Fox Steak House, 1207 E. Washington Street. Secretary, Miss Edna Rohrabaugh, 816 Robert Street, Lafayette, Ind.

JACKSON-LANSING: Name has been changed. See Central Michigan.

KANSAS CITY meets fourth Thursday of each month at Roselli's Restaurant at 6:30 P.M. Secretary, Olin K. Bock, 5317 W. 58th Street, Mission, Kans.

LANCASTER meets second Friday of each month at 8 P.M. September, December, and April meetings are held at Hanover, York, and Harrisburg, respectively; all other meetings at the Old Mill Inn, Lancaster, Pa. Secretary-treasurer, Harry A. Saylor, 40 N. Poplar Street, Elizabethtown, Pa. Research finance committee chairman, Harry Hovis, Lincoln Highway, West Lancaster, Pa.

LOS ANGELES meets second Wednesday of each month at 7 P.M. in Rodger Young Auditorium. Secretary, Norman K. McEwan, 17222 S. Arlington Avenue, Torrance, Calif. Research finance committee chairman, Tony Stabile, 417 E. 16th Street, Los Angeles 21, Calif.

LOUISVILLE meets third Thursday of each month in Kapfhammers Party House, 1506 S. Shelby Street, Louisville, Ky. Secretary-treasurer, Joseph G. Sterling, 1169 Keller Avenue, Louisville 13, Ky. Research finance committee chairman, R. G. Marshall, 3020 Talisman Road, Louisville 5, Ky.

MELBOURNE meets third Thursday of each month at 8 P.M. in Metallurgy Theatre, Melbourne Technical College, 124 Latrobe Street. Honorary secretary-treasurer, R. W. Lennie, 433 Clarke St., Northcote, Melbourne 16, Australia.

MILWAUKEE meets first Friday of each month in the East Room, Hotel Ambassador. Secretary-treasurer, Clifford A. Peters, 3169 S. 47th Street, Milwaukee 15, Wis. Research finance committee chairman to be appointed.

MONTREAL meets first Tuesday of each month in Mount Royal Hotel. Secretary, Jean Monette, 11700 Notre Dame Street East, Montreal, Canada. Research finance committee chairman, P. M. Coady, c/o Alloycraft, Ltd., 27 Hillside Avenue, Westmount, Montreal 6, Canada.

NEWARK meets third Friday of each month at 8 P.M. in Hotel Robert Treat. Secretary-treasurer, George Wagner, Hy-Grade Electro Plating Company, 35 Fourth Street, Newark, N. J. Research finance committee chairman, John Gumm, 538 Forest Street, Kearny, N. J.

NEW HAVEN meets second Tuesday of each month at Mason Laboratory, Yale University. Secretary-treasurer, B. J. Gaffney, 40 Filbert Street, Hamden 14, Conn. Research finance committee chairman, Dr. H. L. Kellner, c/o Lea Manufacturing Company, 16 Cherry Avenue, Waterbury 86, Conn.

NEW YORK meets second and fourth Fridays of each month in the Statler Hotel. Secretary-treasurer, George Schore, 150 Bennett Avenue, New York 33, N. Y. Research finance committee chairman, Milton Nadel, 41-15 50th Avenue, Long Island City 4, N. Y.

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PHILADELPHIA meets fourth Friday of each month. Meetings are held at the Broadwood Hotel, Franklin Institute, or the Engineers' Club. Secretary, I. William Marcovitch, 1302 St. Vincent Street, Philadelphia 11, Pa. Research finance committee chairman, to be appointed.

PITTSBURGH meets first Wednesday of each month in the Avalon Room of the Sheraton Hotel. Secretary, Irvin H. Schram, Jr., 4782 Delma Drive, Pittsburgh 27, Pa. Research finance committee chairman, Myron Ceresa, 207 Highland Road, Pittsburgh 35, Pa.

PORTLAND meets second Tuesday at 5:30 P.M., in Waddles Restaurant. Secretary-treasurer, K. B. Humphrey, 2750 N. W. 31st Avenue, Portland 10, Ore.

PROVIDENCE-ATTLEBORO meets third Monday of each month in Providence Engineering Society Hall, 195 Angell Street, Providence, R. I. Secretary, Henry Shavier, 32 Hodges Avenue, Taunton, Mass. Research finance committee chairman, Pierre B. Lonsbury, 78 North Avenue, Attleboro, Mass.

ROCHESTER meets third Monday of each month at the 40 & 8 Club, 933 University Avenue. Secretary, Frederick Johnson, 21 Shire Oaks Drive, Pittsford, N. Y. Research finance committee chairman, Clarence VanEpps, 305 Hurstburne Road, Rochester 9, N. Y.

ROCKFORD meets second Monday of each month in Faust Hotel. Secretary-treasurer, E. J. Budden, 122 Twelfth Street, Rockford, Ill. Research finance committee chairman, David Stockton, the Udylite Corporation, 1943 Walnut Street, Chicago 12, Ill.

SAGINAW VALLEY meets for dinner at 6:45 P.M. and for educational session at 8:00 P.M. at Zehnder's, Frankenmuth, Mich., second Wednesday of each month, September through May, except February. Secretary-treasurer, Dennis J. Goddeyne 1300 N. McLellan St., Bay City, Mich.

ST. JOSEPH VALLEY meets first Wednesday of each month at 8 P.M. in Elkhart Hotel, Elkhart, Ind. Secretary-treasurer, Eugene Roth, 739 N. College Street, South Bend 28, Ind. Research finance committee chairman, Ralph Brouwer, 361 Maple Avenue, Holland, Mich.

ST. LOUIS meets second Wednesday of each month at the York Hotel, 6th and Market, St. Louis, Mo. Secretary-treasurer, E. R. Hunleth, 4415 Michigan Avenue, St. Louis, Mo. Research finance committee chairman, to be appointed.

SAN ANTONIO. Regular meeting date to be announced. Secretary-treasurer, Joseph C. Brown, c/o Friedrichs' Refrigerators, Inc., 1117 E. Commerce Street, San Antonio, Texas.

SAN FRANCISCO meets second Thursday of each month, alternating between St. Julien Restaurant, 140 Battery Street, San Francisco, and El Curtola Restaurant, 510 17th Street, Oakland. Secretary-treasurer, Floyd W. Browning, c/o L. H. Butcher Co., 15th and Vermont Streets, San Francisco, Calif. Research finance committee chairman to be appointed.

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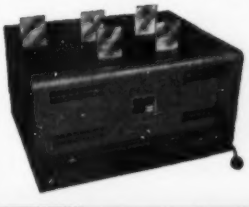

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SEATTLE. Regular meeting date to be announced. Secretary, Mrs. Helen Archibald, 17560 Tenth Avenue, N. W. Seattle, Wash.

SOUTHEASTERN meets second Friday of each month at the Belmont Steak House, Atlanta, Ga. Secretary-treasurer, W. T. Weymouth, 173 Clay Street, S. E., Atlanta, Ga.

SOUTHERN TIER. Regular meeting date to be announced. Secretary, Vincent T. Maxian, 3 Wilson Street, Binghamton, N. Y.

SPRINGFIELD meets fourth Monday of each month in Blakes Restaurant, 15 Market Street, Springfield, Mass. Secretary, Henry L. Heissfeld, 74 Chilson Street, Springfield 8, Mass. Research finance committee chairman, John E. Costigan, 74 Clairmont Avenue, Longmeadow, Mass.

SYDNEY meets second Thursday of each month at 7:30 P.M. at 155 King St., Sydney. Secretary-treasurer, M. Taylor, 44 Aubin St., Neutral Bay, N.S.W., Australia.

SYRACUSE meets third Monday of each month in Richard's Restaurant. Secretary, Lindley Wood, 1329 Bellevue Avenue, Syracuse 4, N. Y. Research finance committee chairman, K. S. Parnell, 829 Maryland Avenue, Syracuse, N. Y.

TOLEDO meets first Thursday of each month at Park Lane Hotel. Dinner 6:30 P.M.; meeting 8 P.M. Secretary-treasurer, Gaston Bergeman, 703 Pine Street, Fremont, Ohio.

TORONTO meets second Friday of each month in Royal York Hotel. Dinner 6:30 P.M.; meeting 8:30 P.M. Secretary, Robert L. Edwards, 1106 Dovercourt Road, Toronto, Ontario, Canada. Research finance committee chairman, K. Wells, 370 Victoria Avenue, Toronto, Ontario, Canada.

TWIN CITY meets first Monday of each month, October through June, in the Covered Wagon (Lodge Room), 114 S. 4th Street, Minneapolis, Minn., with dinner at 6:30 P.M. and business and technical session at 8:00 P.M. Secretary-treasurer, Robert L. Buckley, c/o Industrial Chemical and Equipment Company, 205 11th Avenue So., Minneapolis 15, Minn. Research finance committee chairman, to be appointed.

WATERBURY meets second Thursday in September through May in Elton Hotel. Dinner 6 P.M.; meeting 8 P.M. Secretary-treasurer, Spencer L. Henn, P. O. Box, Drawer B, Cheshire, Conn.

WESTERN ONTARIO meets third Friday of each month in William Pitt Hotel, Chatham, Ontario. Secretary-treasurer, J. Vollans, 1262 McDougall Street, Windsor, Ontario, Canada.

WICHITA Meeting place indefinite. Secretary-treasurer, Walter Turner, 400 N. Emporia, Wichita, Kans.

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72 Machines Introduced at First Metal Finishing Show

A small but rugged resinall metalite cloth belt does a full size job of removing cutting marks from enclosed areas. (A Jon-Vir Belt Grinding attachment.)

COATED ABRASIVES

On November 16 to 19 at the new Behr-Manning headquarters and warehouse in Chicago some seventy-two new machine tools using abrasive belts were shown by thirty-eight manufacturers.

This was the First (but probably not the last) Metal Finishing Show and Conference.

Perhaps the most impressive part of the show was the great number of technical specialists who gathered there from the coated abrasives and machine manufacturing fields.

The tremendous ingenuity applied to new uses and new methods was in itself a tribute to American progress. Perhaps Arthur W. Bell's statement, "The new coated abrasives, contact wheels, lubricants, machines and polishing techniques which have made this conference and showing possible, represent (along with the new transfermatic tools) the hottest corner of equipment development in the machine tool industry—and open the door to remarkable production economies just when the industry needs them most" is a wiser one than it may seem to be at first blush.

Mr. Bell is Midwest Regional Manager for Behr-Manning. He has lived with belt polishing techniques since their "diaper" days.

This insert is the result of a simple visit by your editor. The pictures form a sort of album record of that visit, but they cannot encompass the vast fields represented nor can they begin to convey the expansive new fields of economy and production which were revealed there.

H. W. Westlund, Divisional Product Engineer with Behr-Manning here donned a work coat to demonstrate a polishing operation which might easily save many a company money.

Merritt Products Co.'s Grind-O-Flex wheel, composed of hundreds of leaves of coated abrasive cloth mounted on a refillable hub. It is ideal for polishing irregular and recessed areas.

Dr. Ralph Schaefer at the metal finishing show. He was snapped here in the Behr-Manning exhibit—after the excellent dinner given the press members by that company.

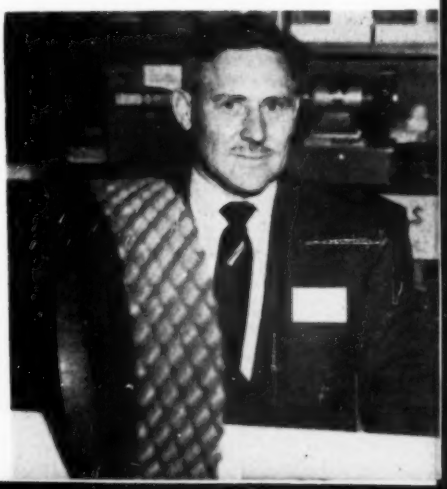
This conveyor fed coated abrasive belt grinding and polishing machine is making drawn strip stock. Six foot lengths are accurately ground by this method. (Curtis 600-C.) In the inset, a company representative demonstrates a much smaller but not less accurate Curtis machine.

George R. Carlson of Acme Manufacturing Co. in his exhibit. Acme showed a variety of machines in many sizes, along with the intricate products the machines can handle.

John Zimm, left, demonstrating Divine Brothers Co. variable speed polishing lathes. Speeds are variable from 1800 to 3500 rpm; meets sfm requirements of buff or contact wheel as wear reduces the diameter.

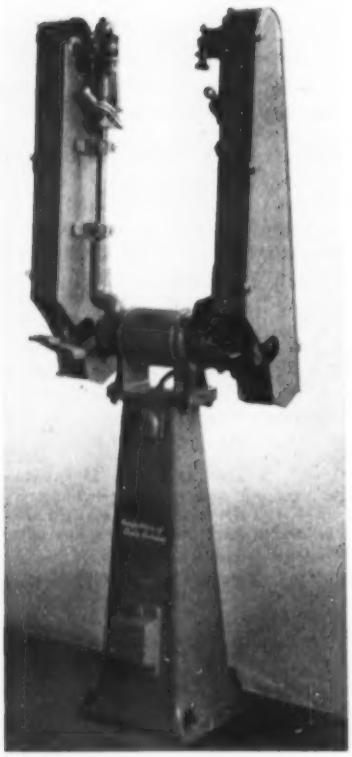
Mead Specialties Co.'s Don Finlayson operates the Mead Burring Machine. The versatility of the little tool is impressive. It adapts easily to inside or outside sanding.

William Cosmos, President, Chicago Rubber Co. and inventor of backup wheels sits with his latest development: a new type serrated contact wheel.



CONTACT GRINDING & POLISHING MACHINE

CURTIS MODEL DBA-1



- General purpose grinding, polishing and deburring lathe.
- Adjustable extension arms permit horizontal or vertical operation for coated abrasive applications.
- Heavy duty double end spindle permits grinding wheel, wire brush, buffing wheel operations with no machine fatigue.
- Constructed for either bench or pedestal type operation.
- Floor space 29" x 12".
- Electrical specifications: 1¼ H.P. 3400 R.P.M.

Precision Built Grinding and Polishing Machines Since 1897

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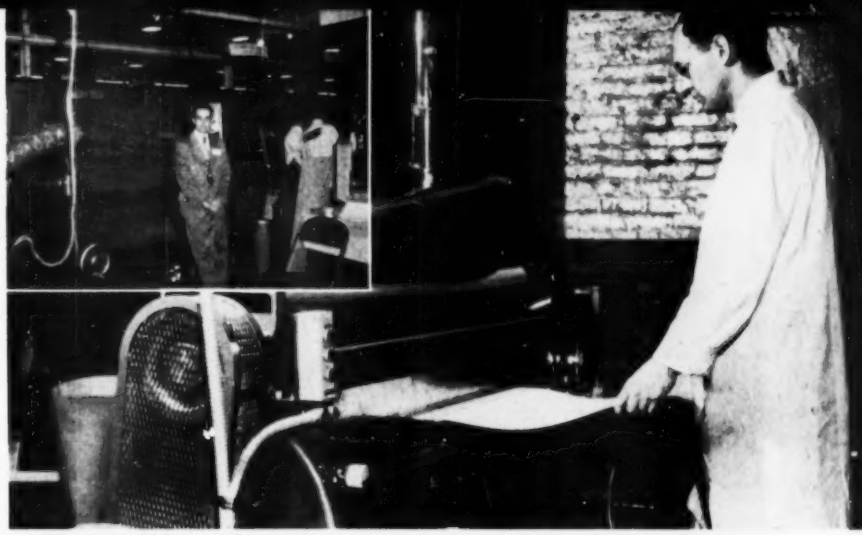
The impressive Micro-polish Murray Way machine. R. J. Zech, Adm., is on the left feeding the machine; R. W. Redmond, Sales Manager, on the right.



This Curtin-Hebert machine is for precision production sanding. It is capable of accurate grinding to within 0.00025 in. To date, it has been used mostly on mica, plastic laminates, masonite, etc. In the inset, George M. Curtin, Jr., vice-president of Curtin-Hebert, leans against the model at the show. With it, he was sending the print from newspapers to show the machine's accuracy.

C. A. Kommer of United Machine Tool Co. demonstrates their small burring machine. Its usefulness is attested to by the fact that some of the leading metals companies have a number in operation for offhand deburring, grinding, or contour polishing.

R. A. Hummert (left) and J. J. Howe hold a pair of small sanders made by Porter-Cable Machine Co. This same company also makes large machines with automatic feeds and speed controls.

Operator uses free area of Coated Abrasive belt to strap and polish tight contours of this part. Model CN-2 Engelburg-Huller.

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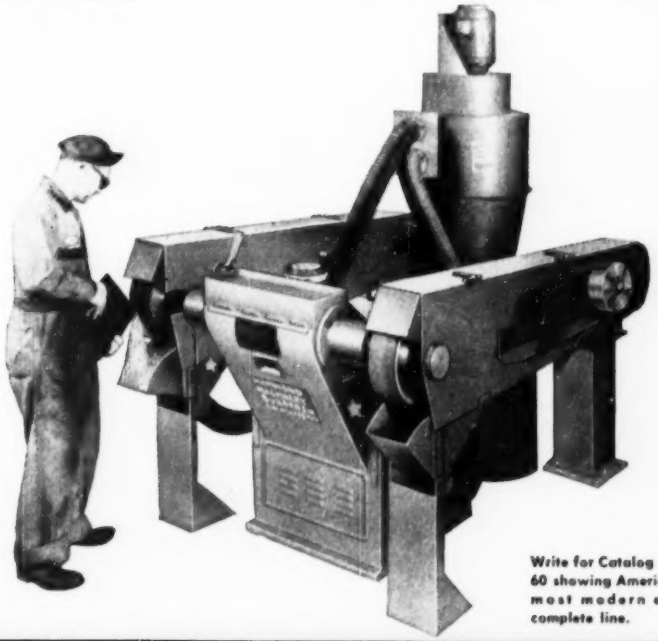

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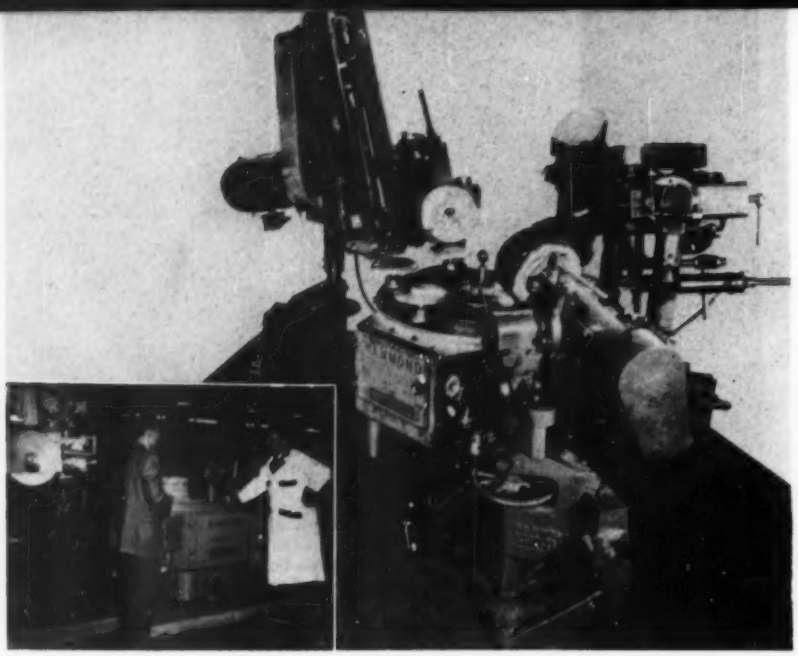
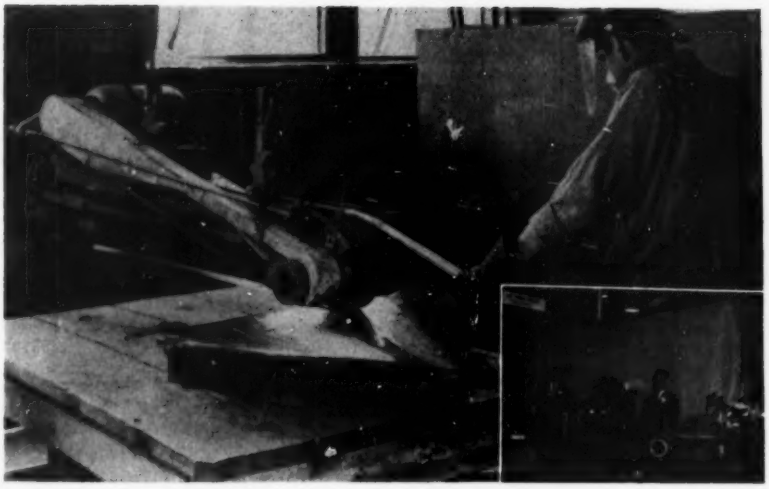


This view of the Hammond Rotary Automatic shows both Coated Abrasive belt attachment and Buffing Stations. These machines serve all phases of the automobile electrical appliance, brass goods, hardware and other mass production industries. That's Lee Albrecht, Field Representative, in the coat at the right (in the inset) chatting with one of the hosts from Behr-Manning.



Versatile, rugged and powerful is this 7½ hp Ryman Swing Frame Grinder. Designed for hogging welds and cleaning up metal, this machine takes advantage of the cooler cutting of coated abrasive belts. In the inset are Walter L. Ryman, vice-president, Ryman Engineering Co. (right), and on the left, Robert E. Reid of the Engis Engineering Co. (who represent Ryman in Chicago).

Polishing the intricate contours of a die with a Mall Pneumatic small band grinder. Abrasive bands, mounted on mandrels can be used at speeds up to 100,000 rpm for polishing purposes. In the inset, Robert Schneider.

Behr-Manning "know-how"...

can give you better, quicker plating finishes

Bader Space Saver — Made and sold by Stephen Bader & Company, Valley Falls, N. Y.

Take the question of abrasive belt loading. Get the *right* grease on the *right* BEHR-MANNING® Abrasive Belt, and your production can zoom upward like a jet-plane on a fast take-off, with a beautiful preplating finish that can't be beat.

It's a case of abrasive "know-how"—which is one of BEHR-MANNING'S chief products. You'll find it ready to serve you at your nearby BEHR-MANNING Demonstration Room, where your polishing operations can be reviewed and tried out in new, modern ways. Phone or write your local BEHR-MANNING Representative.

Inside story on lubrication . . . with abrasive belts, in this reprint from Machinery Magazine. Write for your copy to Behr-Manning, Troy, N. Y., Dept. **PL-12**

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P5

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Future Meetings

AIME, Electric Furnace Steel Conference, William Penn Hotel, Pittsburgh, Pa., December 1–3, 1954.

Detroit Branch, AES, annual meeting, Hotel Statler, December 3–4, 1954.

Syracuse Branch, AES, annual meeting, New York, December 4, 1954.

American Institute of Chemical Engineers, annual meeting, Statler Hotel, New York, December 12–15, 1954.

Newark Branch, AES, annual meeting, Hotel Robert Treat, December 18, 1954.

American Association for the Advancement of Science, national meeting, University of California, December 26–31, 1954.

AIME, Connecticut Local Section, Bridgeport, January 12, 1955.

Plating Editorial Board, National Headquarters, Newark, N. J., January 21, 1955.

AES Research Committee, Conrad-Hilton, Chicago, Illinois, January 28, 1955.

AES Executive Board, Research Committee, Conrad-Hilton, Chicago, Illinois, January 29, 1955.

Chicago Branch, AES, annual meeting, Conrad-Hilton, January 29, 1955.

American Society for Testing Materials, 1955 Committee week, Cincinnati, January 31–February 4, 1955.

American Institute of Mining and Metallurgical Engineers, annual meeting, Chicago, February 13–17, 1955.

AIME, annual meeting, Conrad-Hilton, Chicago, Illinois, February 14–17, 1955.

Dayton Branch, AES, annual meeting, Hotel Biltmore, Dayton, Ohio, February 19, 1955.

Grand Rapids Branch, AES, annual meeting, Pantlind Hotel, February 19, 1955.

Capitol District, annual meeting, Menands, New York, March 7, 1955.

Waterbury Branch, AES, annual meeting, Hotel Elton, Waterbury, March 10, 1955.

Baltimore-Washington Branch, AES, annual meeting, Washington, D. C., March 12, 1955.

AIME, Connecticut Local Section, annual meeting, Statler Hotel, Hartford, Connecticut, March 16, 1955.

Louisville Branch, AES, annual meeting, Louisville, Kentucky, March 17, 1955.

Second Annual Tri-State National Meeting, AES, Columbus, Ohio, March 26, 1955.

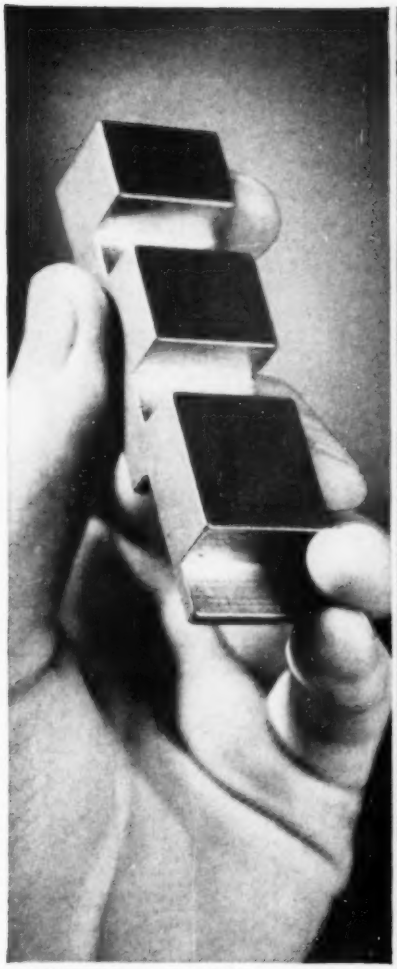
Cincinnati Branch, AES, annual meeting, Columbus, Ohio, March 26, 1955.

Ninth Western Metal Exposition, Pan-Pacific Auditorium, and Ninth Western Metal Congress, Ambassador Hotel, Los Angeles, March 28–April 1, 1955.

American Chemical Society, 127th meeting, Cincinnati, March 29–April 7, 1955.

Third National Air Pollution Symposium, Pasadena, California, April 16–19, 1955.

42nd Annual AES Convention and 4th Industrial Finishing Exposition, Municipal Auditorium, Cleveland, June 20–23, 1955.



This part once cost 21½¢ per piece to finish. The manufacturer investigated barrel finishing and decided to give it a trial.

This method — barrel finishing — proved a sensational cost cutter. The medium is Norton ALUNDUM* Tumbling Abrasive. The cost per finished part today is 5½¢!

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Are you taking advantage of Norton ALUNDUM tumbling abrasive in your work?

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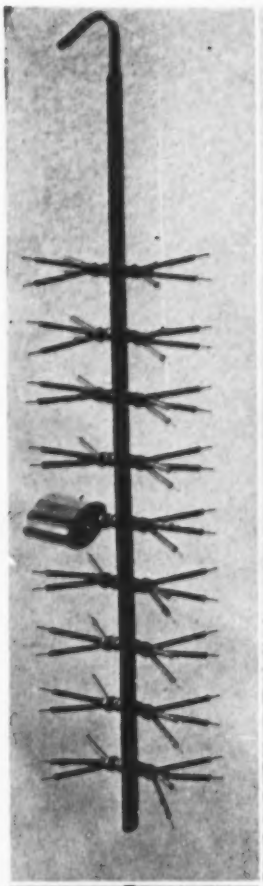

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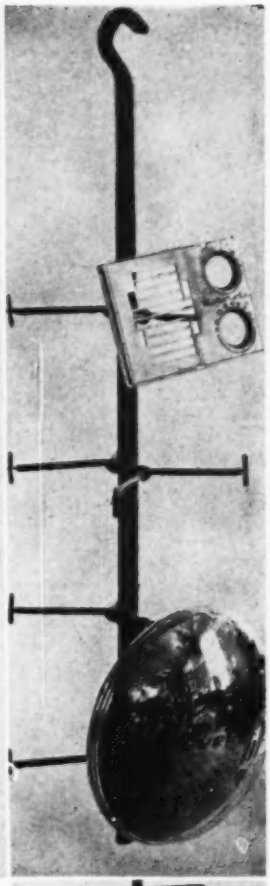

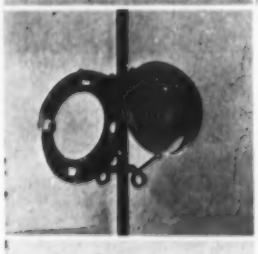

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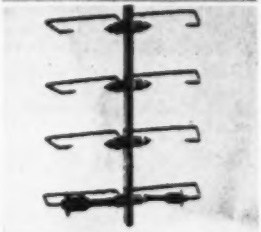

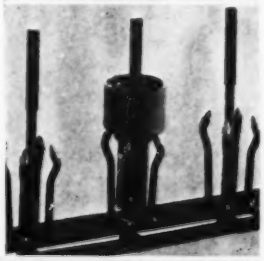

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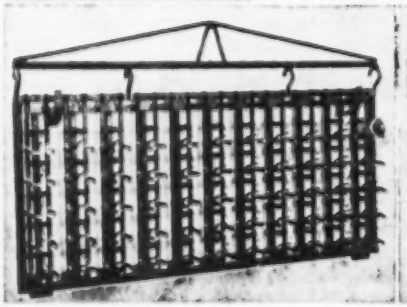

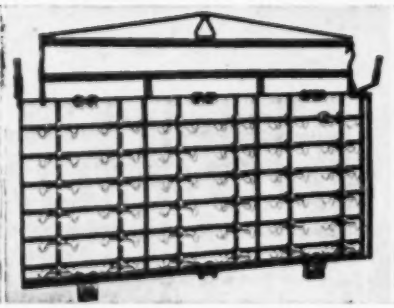

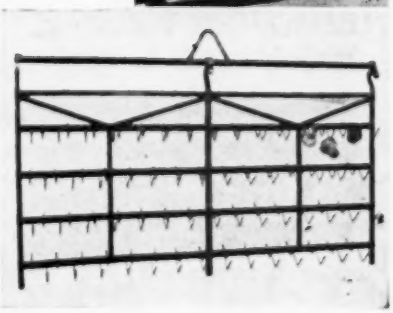

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"Many, merry Christmases,
friendships, great accumulation
of cheerful recollections,
affection on earth and Heaven
at last for all of us."

MAC DERMID INCORPORATED . . . *Waterbury 20, Conn.*

20 FOOT STAINLESS STEEL TANKS POLISHED WITH LEA COMPOUND

The
LEA GROUP
serving the Finishing Field
The Lea Mfg. Co., Waterbury, Conn.
Lea-Michigan, Inc., Detroit
Lea-Ronal, Inc., Long Island City, N. Y.
Lea Mfg. Co., of Canada, Toronto
Plating Polishing Buffing
Burring

Brewing is one of those processes that requires the utmost in sanitary protection — hence the *stainless steel* for this starting tank being fabricated by the Nooter Corporation of St. Louis for the Anheuser-Busch brewery in Los Angeles, the first all stainless steel equipped brewhall in this country.

Brewers too, insist upon *smooth contact surfaces* which promote maximum efficiency in cleaning and sterilization. No rough spots to harbor food bacteria. And the "spic and span" appearance of smooth gleaming surfaces is of no small importance. Hence the polishing!

In the picture above you see a polisher putting the finishing surface on the interior of one of a group of six 20 foot stainless steel tanks and he's polishing it with one of the many grades of Lea Compound.

The point we want to make is not merely that in the Nooter plant they are using Lea Compound for polishing their stainless steel tanks. It's the technical skill and advisory service available at Lea to help *any* company determine the best polishing and finishing method for each item to be finished. That comes first. All Lea Compositions are of the highest quality but only one composition or series of compositions is likely to be best for any given finishing step. Lea Technicians will be glad to tell you which method and which composition.

Why not let Lea help you with your finishing problem? Write in detail as to your requirements and, if possible, send samples of the work to be finished.

LEA GRIPMASTER®
POLISHING WHEEL CEMENT
matching the high quality of other Lea Products, is now obtainable through
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